Public Draft | State Clearinghouse #2009012081

Sacramento River Bank Protection Project Environmental Impact Statement/ Environmental Impact Report

November 2014

Prepared for:

U.S. Army Corps of Engineers and Central Valley Flood Protection Board

Prepared by:

ICF INTERNATIONAL

HDR Engineering, Inc.

US Army Corps of Engineers ®
Sacramento District

Central Valley Flood Protection Board

PUBLIC DRAFT
SACRAMENTO RIVER BANK PROTECTION PROJECT
ENVIRONMENTAL IMPACT STATEMENT/ ENVIRONMENTAL IMPACT REPORT

STATE CLEARINGHOUSE #2009012081

PREPARED FOR:

U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814
Contact: Brian Mulvey
916-557-6708

Central Valley Flood Protection Board
3310 El Camino Avenue
Sacramento, CA 95821
Contact: Kip Young
916-574-2559

PREPARED BY:

ICF Jones & Stokes
630 K Street, Suite 400
Sacramento, CA 95814
Contact: Gregg Ellis
916-737-3000

November 2014

ICF International. 2014. Sacramento River Bank Protection Project Environmental Impact Statement/Environmental Impact Report. Public Draft. November. (ICF 00627.08.) Sacramento, CA. Prepared for U.S. Army Corps of Engineers and Central Valley Flood Protection Board, Sacramento, CA.

PUBLIC DRAFT

Sacramento River Bank Protection Project
Environmental Impact Statement/Environmental Impact Report
being jointly pursued by the U.S. Army Corps of Engineers
and the Central Valley Flood Protection Board

The U.S. Army Corps of Engineers (Corps) and the Central Valley Flood Protection Board (CVFPB) have prepared this joint programmatic environmental impact statement/environmental impact report (EIS/EIR) for the Sacramento River Bank Protection Project (SRBPP) Phase II Supplemental Authority (proposed program) for implementation of up to 80,000 linear feet (LF) of additional bank protection in the Sacramento River Flood Control Project (SRFCP) area, as authorized by Section 3031 of the Water Resources Development Act (WRDA) of 2007. The proposed program area spans portions of Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties in California. The Corps is the federal lead agency for this EIS/EIR, and the CVFPB is the state lead agency, pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), respectively.

This programmatic EIS/EIR analyzes the environmental effects associated with implementing bank protection measures along 80,000 LF of the SRFCP to arrest or avoid streambank erosion that threatens the integrity of the SRFCP levee system. Five programmatic action alternatives are proposed, consisting of different combinations of the following measures: setback levees, adjacent levees, riparian and wetland benches with revegetation, bank fill stone protection with on-site woody vegetation, and bank fill stone protection with no on-site woody vegetation. Because streambank erosion is episodic and new erosion sites can appear each year, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety, but relying on data associated with 106 representative sites in order to provide the most detailed programmatic analysis possible. Additional project-level environmental documentation, tiering from this programmatic analysis, will be prepared in the future to address specific sites that will be constructed.

For further information on this EIS/EIR, please contact:

Mr. Brian Mulvey
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814
916-557-7660

or

Mr. Kip Young
Central Valley Flood Protection Board
3310 El Camino Avenue
Sacramento, CA 95821
916-574-2559

Comments on the EIS/EIR must be provided by February 27, 2015. Comments may be submitted by email to SacRiverBank@usace.army.mil .

Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
ADAM	Aerometric Data Analysis and Management System
Alquist-Priolo Act	Alquist-Priolo Earthquake Fault Zoning Act
APE	area of potential effects
ARB	Air Resources Board
ARPA	Archaeological Resources Protection Act
ATR	Agency Technical Review
BA	biological assessment
BAAQMD	Bay Area Air Quality Management District
Basin Plan	Central Valley RWQCB’s Water Quality Control Plan
BCAQMD	Butte County Air Quality Management District
BCFD	Butte County Fire Department
BLM	U.S. Bureau of Land Management
BMPs	Best Management Practices
CAA	Clean Air Act
CAL FIRE	California Department of Forestry and Fire Protection
CalEPA	California Environmental Protection Agency
Cal-IPC	California Invasive Plant Council
CCAA	California Clean Air Act
CCAPCD	Colusa County Air Pollution Control District
CCR	California Code of Regulations
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
Central Valley RWQCB	Central Valley Regional Water Quality Control Board
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	Methane
CHP	California Highway Patrol
CHRIS	California Historical Resources Information System
cm	centimeters

CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
Common Features	American River Common Features Project
Comp Study	Sacramento–San Joaquin River Basins Comprehensive Study
Corps	U.S. Army Corps of Engineers
CRHR	California Register of Historical Resources
CSAs	county service areas
CSD	community service district
CSU Chico	California State University, Chico
CVFPA	Central Valley Flood Protection Act
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CVIFMS	Central Valley Integrated Flood Management Study
CVP	Central Valley Project
CWA	Clean Water Act
CWT	coded wire tag
Db	Decibel
Dba	A-Weighted Decibel
Dbh	diameter at breast height
DDR	Design Document Report
DDT	dichlorodiphenyltrichloroethane
DE	Diatomaceous Earth
Delta	Sacramento–San Joaquin River Delta
Delta	Sacramento Valley and Sacramento-San Joaquin Delta
Delta Study	Delta Islands and Levee Feasibility Study
DFW	California Department of Fish and Wildlife
DO	dissolved oxygen
DOI	Secretary of the Department of the Interior
DPM	diesel particulate matter
DPR	Department of Parks and Recreation
DPS	distinct population segment
DSC	Delta Stewardship Council
DTSC	Department of Toxic Substances Control
dW:dH	distance width to distance height

DWR	California Department of Water Resources
EC	electrical conductivity
ECT	Electronic Calculation Template
EDR	Engineering Documentation Report
EFH	essential fish habitat
EIP	Early Implementation Program
EIR	Environmental Impact Report
EIS	environmental impact statement
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
Environmental Checklist	State CEQA Guidelines
EPA	U.S. Environmental Protection Agency
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FAA	Federal Aviation Administration
Final	Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II
FMMP	Farmland Mapping and Monitoring Program
FMWT	Fall Midwater Trawl
formerly The Reclamation Board	Central Valley Flood Protection Board Encroachment Permit
FPDs	fire protection districts
fps	feet per second
FR	Federal Register
FRAQMD	Feather River Air Quality Management District
FRFH	Feather River Fish Hatchery
g	gravity
GCAPCD	Glenn County Air Pollution Control District
GCID	Glenn-Colusa Irrigation District
GHGs	Greenhouse gases
GIS	geographic information system
GPTU	Butte County General Plan Technical Update
GRR	General Reevaluation Reports
GWP	global warming potential
HAPs	Hazardous Air Pollutants
HCPs	habitat conservation plans

HEC-RAS	Hydrologic Engineering Center's River Analysis System
HPTP	Historic Properties Treatment Plan
I-5	Interstate 5
IPCC	Intergovernmental Panel on Climate Change
ITAs	Indian Trust Assets
IWG	Interagency Working Group
IWM	instream woody material
L_{eq}	Equivalent Sound Level
LF	linear feet
LFRCMP	Lower Feather River Corridor Management Plan
LM	Levee Mile
LMAs	local maintaining agencies
L_{max} and L_{min}	Maximum and minimum sound levels
LOS	level-of-service
L_{peak}	Peak Sound Level
LRR	Limited Reevaluation Report
L_{xx}	Percentile-Exceeded Sound Level
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MBTA	Migratory Bird Treaty Act
milligrams per liter	mg/l
mm	millimeter
MMP	maintenance and monitoring plan
MOA	Memorandum of Agreement
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSEWs	Mechanically stabilized earth walls
MSL	mean sea level
N_2O	Nitrous oxide
NAGPRA	Native American Graves Protection and Repatriation Act
NAHC	Native American Heritage Commission
NCCPs	Natural Community Conservation Plans
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLIP	Natomas Levee Improvement Project
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NOP	Notice of Preparation

NO_X	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NTUs	nephelometric turbidity units
O&M	operation and maintenance
PA	Programmatic Agreement
PCAPCD	Placer County Air Pollution Control District
PCBs	polychlorinated biphenyls
PCWA	Placer County Water Agency
PDT	Project Delivery Team
PG&E	The Pacific Gas and Electric Company
pH	potential of hydrogen
PM10	particulate matter smaller than 10 microns or less in diameter
PM2.5	2.5 microns or less in diameter
ppm	parts per million
ppt	parts per thousand
PPV	peak particle velocity
PRC	Public Resources Code
proposed program	Phase II Supplemental Authority
RBDD	Red Bluff Diversion Dam
RD	Reclamation District
RM	river mile
ROG	reactive organic gases
RSSs	reinforced soil slopes
SAFCA	Sacramento Area Flood Control Agency
salmon FMP	Pacific Coast Salmon Fishery Management Plan
SAM	Standard Assessment Methodology
SBFCA	Sutter Butte Flood Control Agency
SCSD	Sutter County Sheriff's Department
SCWA	Sacramento County Water Agency
SFBAAB	San Francisco Bay Area Air Basin
SHPO	State Historic Preservation Officer
SIA	Sacramento International Airport
SIP	State Implementation Plan
SLC	California State Lands Commission
SMAQMD	Sacramento Metropolitan Air Quality Management District

SMARA	California Surface Mining and Reclamation Act of 1975 (PRC Section 2710 et seq.)
SMDs	sewer maintenance districts
SMUD	Sacramento Municipal Utility District
SO_X	Sulfur Oxides
SPCCP	Spill Prevention, Control, and Countermeasure Plan
SR	State Route
SRA	shaded riverine aquatic
SRBPP	Sacramento River Bank Protection Project
SRBPPD	Sacramento Riverbank Protection Project Database
SRCSD	Sacramento Regional County Sanitation District
SRFCP	Sacramento River Flood Control Project
SRPS	South River Pump Station
SRRV	Sacramento River Riparian Vegetation
SVAB	Sacramento Valley Air Basin
SWP	State Water Project
SWPPP	Stormwater Pollution Prevention Plan
TAC	Toxic Air Contaminant
TCAPCD	Tehama County Air Pollution Control District
TCD	temperature control device
TCFD	Tehama County Fire Department
TCP	traditional cultural properties
TCSLA	Tehama County Sanitary Landfill Association
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
TNS	Townet Survey
TRLIA	Three Rivers Levee Improvement Authority
TSS	total suspended sediment
UBC	Uniform Building Code
US-50	Highway 50
USC	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
UYLIP	Upper Yuba River Levee Improvement Project
valley	Sacramento Valley

Vegetation ETL	Guidelines for Landscape Planting and Vegetation Management at Floodwalls, Levees, Embankment Dams, and Appurtenant Structures
VFZ	vegetation-free zone
VRAP	Visual Resources Assessment Procedure
WDRs	Waste Discharge Requirements
WHMP	Wildlife Hazard Management Plan
WRDA	Water Resources Development Act
WSAFCA	West Sacramento Area Flood Control Agency
YSAQMD	Yolo-Solano Air Quality Management District
YSDI	Yuba-Sutter Disposal, Inc.
µS/cm	microSiemens per centimeter

Executive Summary

Introduction

This joint programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) has been prepared for the Sacramento River Bank Protection Project (SRBPP) Phase II Supplemental Authority (proposed program) for implementation of up to 80,000 linear feet (LF) of additional bank protection in the Sacramento River Flood Control Project (SRFCP) area, as authorized by Section 3031 of the Water Resources Development Act (WRDA) of 2007 (Public Law [Pub. L.] No. 110-114, Section 3031, 121 Statutes [Stat.] 1041, 1113 (2007)). This EIS/EIR has been prepared by the U.S. Army Corps of Engineers (Corps), which is federal lead agency, and the Central Valley Flood Protection Board (CVFPB) (formerly The Reclamation Board), which is the state lead agency, in accordance with the requirements of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

The purpose of this EIS/EIR is to disclose the environmental impacts and recommended mitigation measures related to a proposed program and alternatives prior to making a decision on program approval. A joint document may be prepared when both a federal and a state agency are involved. Both NEPA and CEQA provide guidelines for the preparation of a programmatic EIS/EIR.

Project Location

The SRBPP area (also referred to as the program area) is located along the Sacramento River and its tributaries and distributaries and spans Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties, California (Figure ES-1). The alternatives covered in this programmatic EIS/EIR are those associated with future repair of bank erosion sites on an additional 80,000 LF within the program area.

The program area extends south-to-north along the Sacramento River from the town of Collinsville at river mile (RM) 3 upstream to Chico at RM 194, and includes reaches of lower Elder and Deer Creeks. The program area also includes Cache Creek, the lower reaches of the American River (RM 0–23), Feather River (RM 0–61), Yuba River (RM 0–11), and Bear River (RM 0–17), as well as portions of Threemile, Steamboat, Sutter, Miner, Georgiana, and Cache Sloughs. Sutter and Yolo bypass levees are also located in the program area.

Purpose and Need and Objectives

The SRBPP is a multi-year program to repair erosion problems affecting levees that are part of the SRFCP, which protects more than 1 million acres of agricultural land and communities in the Sacramento Valley and Sacramento–San Joaquin Delta (Delta). The levees in the central reaches of the Sacramento River were established close to streambanks to erode vast sediment deposits accumulated from hydraulic mining in the Sierra Nevada in the 1800s and to facilitate use of rich floodplain soils for agriculture. This sediment-removal purpose was met by about 1940, but the rivers, deprived of the natural energy dissipation of floodplains, have continued to erode laterally, often undermining the toe of adjacent levees. This ongoing problem has two potential solutions as authorized under the SRBPP (The River Basin Monetary Authorization Act of 1974 (Pub. L. 93-251, Section 202): 1) setback of levees to reduce floodflow depths and velocities and, thus, erosion of natural banks, or 2) armoring existing or restored streambanks to resist the erosion.

The program purpose and objective is to arrest or avoid streambank erosion that threatens the integrity of the SRFCP levee system. To protect property as well as the health and safety of residents, bank repair and levee rehabilitation are needed at erosion sites. The proposed program will also attempt to greatly minimize erosion, limiting the eventual loss of nearshore aquatic habitat and riparian habitat that would likely occur if the proposed program were not enacted.

Implementation of an additional 80,000 LF of bank protection would ensure the continued integrity of SRFCP levees while protecting environmental resources and compensating for significant effects to the degree feasible. Levees within the program area provide flood damage risk reduction for the Sacramento Valley and help convey water flowing from the Sierra Nevada to the Delta. Levees stressed by high winter flows can weaken and fail; to maintain the integrity of the flood control system, locations with a high failure potential would be identified and remedied through project implementation.

As part of the annual field reconnaissance reviews of the SRFCP, the Corps and its local sponsor, the CVFPB, have found that the number of documented bank erosion sites in the inventory is increasing. Specifically, the total number of erosion sites for the SRFCP increased from 152 in 2007 to 201 in 2012, despite some sites being repaired and status changes of other sites between the inventories (Ayres Associates 2008:5; U.S. Army Corps of Engineers 2013:27).

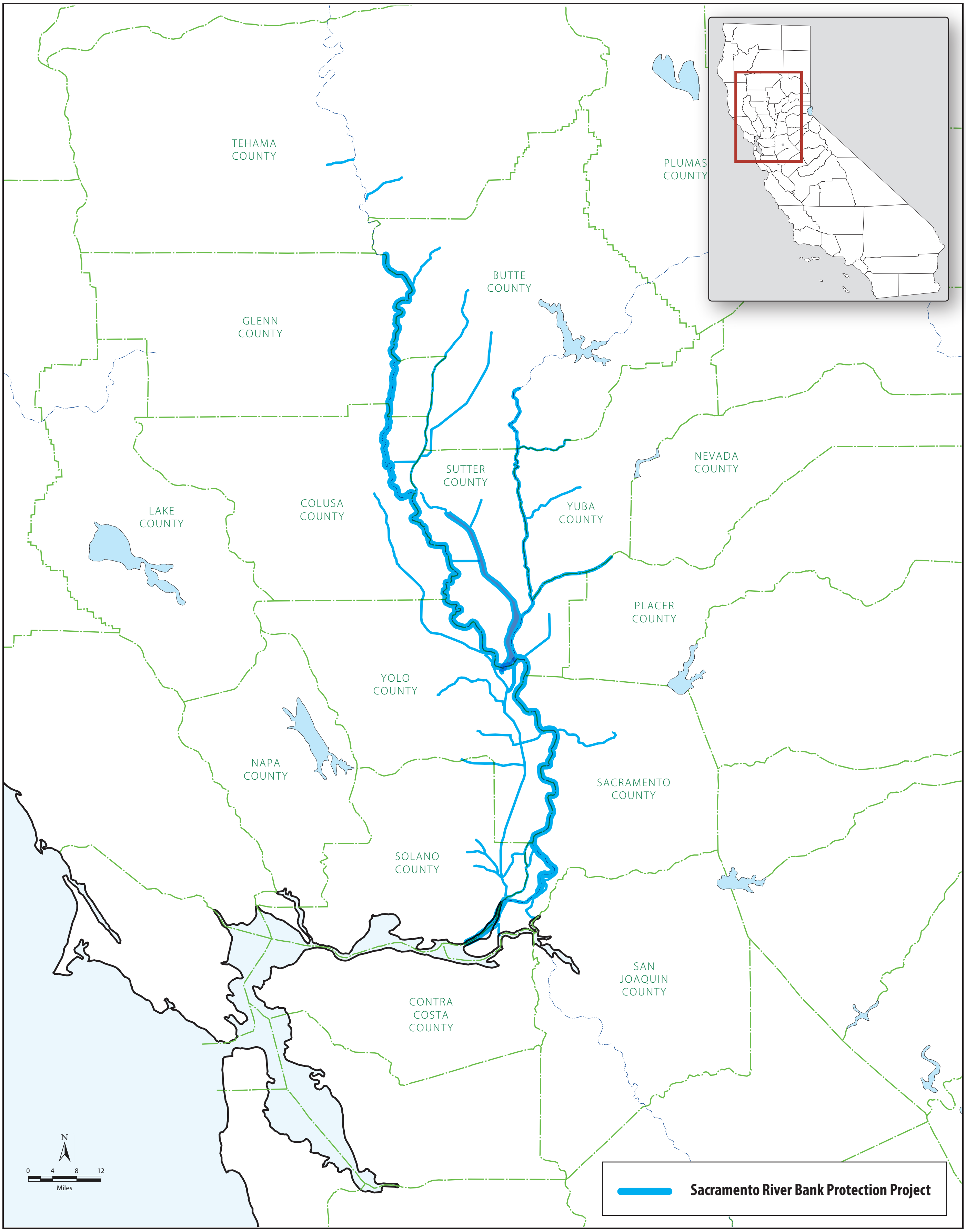
Summary Description of the Project

SRBPP Background

The original authorization for SRBPP in 1960 and a Phase II authorization in 1974 approved the construction of up to 835,000 LF of bank protection. The SRBPP is a continuing long-term project authorized by Section 203 of the Flood Control Act of 1960 (Pub. L. No. 86-645, Section 203, 74 Stat. 480, 498 (1960)).

The SRBPP was authorized to provide bank protection to maintain the integrity of the SRFCP through bank stabilization using stone protection and levee setbacks. Other methods recommended by the State of California have also been tested from time to time, including permeable dike systems (palisades) and dredge berms. The SRFCP consists of more than 1,000 miles of levees, plus overflow weirs, pumping plants, and bypass channels.

The SRBPP is a local cooperation project. The Corps' Sacramento District serves as the federal participant responsible for implementation of the SRBPP with its non-federal partner, the CVFPB, the state agency designated for non-federal responsibilities and cost sharing. The Corps (NEPA lead agency) and the CVFPB (CEQA lead agency) (referred to herein as Lead Agencies) have determined that a joint programmatic EIS/EIR is the most appropriate means to comply with both NEPA and CEQA because of the need for coordination among federal and state agencies, and the need to complete environmental review expeditiously.



Graphics/Projects/06207.08 Sac Bank/ ES (07-09) SS

Figure ES-1
Program Vicinity

WRDA of 2007 authorized construction of an additional 80,000 LF of bank protection under the Phase II authorization. In 2008, the Corps' Sacramento District initiated development of a program of action for this work under policies set forth in the SRBPP authorization and associated reports of the Chief of Engineers, provisions of its Planning Manual (1996) and technical engineering design documents, NEPA, the federal Endangered Species Act (ESA), and other environmental laws.

SRBPP Phases

The SRBPP has been congressionally authorized and implemented in phases. Phase I bank protection was authorized in the Flood Control Act of 1960 for 435,000 LF. It was completed in 1975 and resulted in 435,953 feet of bank protection. Current bank protection is being carried out under Phase II, which was authorized in 1974 for 405,000 LF under the River Basin Monetary Authorization Act of 1974 (Pub. L. No. 93-252, Section 202, 88 Stat. 49 (1974)). Only about 4,966 LF of authorization remained after the 2012 construction season, and plans are under development to construct the final increment. The proposed program, authorized through Section 3031 of the WRDA 2007, is a continuation of Phase II and increases the amount of currently authorized bank protection by 80,000 LF. Phase III (not evaluated as part of this proposed program) would involve future work to protect the SRFCP on which planning has been initiated by the Corps but which currently is not authorized. As construction of the Phase II supplemental authority is completed, implementation of Phase III will be critical to ensuring SRFCP facilities seriously threatened by erosion will receive corrective measures to prevent levee failure, catastrophic damage, and possible loss of life.

Phase II Supplemental Authority (Proposed Program)

The WRDA of 2007 added 80,000 LF of bank protection to Phase II. Before the original 1974 authority runs out of linear footage, a Limited Reevaluation Report (LRR) will be prepared to support revisions to the SRBPP for the additional 80,000 LF. The PAC will demonstrate that the SRBPP Phase II 80,000 LF is technically sound, is compliant with Corps policy, and meets environmental regulations.

The PAC and the supporting Engineering Documentation Report (EDR) will contain a programmatic plan that will apply a representative of 106 erosion sites documented in the Final Alternatives Report (Kleinfelder-Geomatrix 2009). These 106 sites may or may not receive bank protection under the new 80,000 LF authorization. The report lists sites that are scattered along levees on the main Sacramento River, from Collinsville (RM 3) to Chico Landing (RM 194 [while the levees end at RM 184]), and tributaries and distributaries of the Sacramento River. Tributaries include the American River, the Feather River, the Bear River, the Yuba River, and Cache Creek, and distributaries include Steamboat, Sutter, Georgiana, and Cache Sloughs.

For the purposes of this EIS/EIR, the 106 selected erosion sites along the SRFCP are considered for the supplemental 80,000 LF analysis. The number and extent of erosion sites change from year to year because erosion is episodic and new erosion sites can appear each year. The analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional site-specific environmental documentation tiering from this programmatic analysis will be conducted to address sites proposed to be repaired. This EIS/EIR analyzes environmental impacts of constructing 80,000 LF of bank protection on SRFCP levees and increasing the existing Phase II authorization from 405,000 to 485,000 LF.

Proposed Site-Specific Bank Protection Measures

The suite of SRBPP site-specific bank protection measures in the proposed program is described below with figures to support each measure. A bank protection measure is a site-specific design solution to control an existing erosion site while minimizing or mitigating environmental impacts.

The following criteria have been developed for bank protection design, consistent with the project purpose and need.

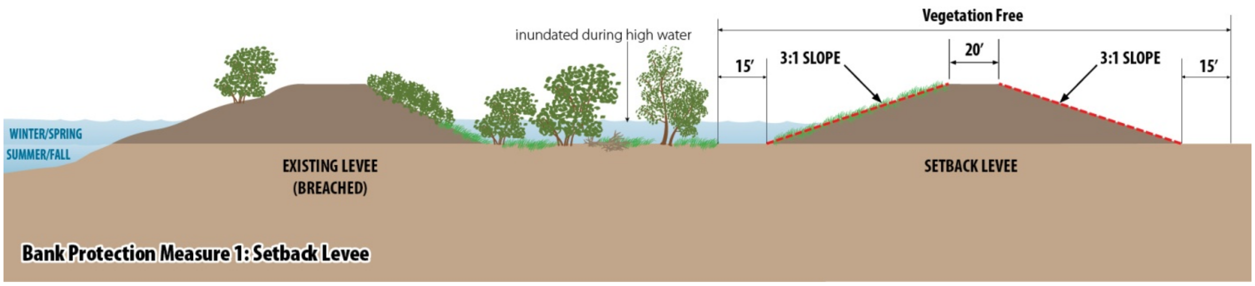
- Restoring the flood damage risk reduction capability of the originally constructed levee through the use of structurally reliable erosion-control elements.
- To the extent practicable, maintaining fish and wildlife habitat and scenic and recreational values, and replacing habitat losses through the use of on-site mitigation elements overlying or integrated with erosion-control elements.
- Fully mitigating off-site significant residual fish and wildlife habitat losses to the extent justified.
- Minimizing costs of construction and maintaining both erosion-control and on-site habitat-mitigation elements.

The following measures are intended to meet these criteria while also meeting the Corps vegetation management policy as prescribed in Engineering Technical Letter 1110-2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures (Vegetation ETL) (U.S. Army Corps of Engineers 2014). For purposes of this EIS/EIR, the vegetation-free zone (VFZ) is defined in the Vegetation ETL and encompasses the existing and new levee footprint area and extending 15 feet outward of each levee toe. Vegetation would be restricted to native grass in the VFZ. These measures are conceptual and will be modified to the degree necessary to be suitable for conditions at any given erosion site. As a result, dimensions in the following figures are typical and will vary based on site-specific conditions and designs.

Bank Protection Measure 1–Setback Levee:

This measure entails constructing a new levee some distance landward of the existing levee and would avoid or minimize construction in the waterside or riparian areas. The land between the setback and existing levee would act as a floodplain. Land use in the new floodplain would be determined on a site-by-site basis. The old levee could be breached in several locations or degraded to allow high flows to inundate the new floodplain. Vegetation on the new setback levee, including 15 feet beyond each toe, would be restricted to grass and managed as a VFZ, while vegetation could remain on the existing levee. New vegetation planted in the setback area could serve as mitigation to offset project losses. Additionally, vegetation on the existing levee could become newly available to aquatic species and contribute to a net increase in floodplain vegetation.

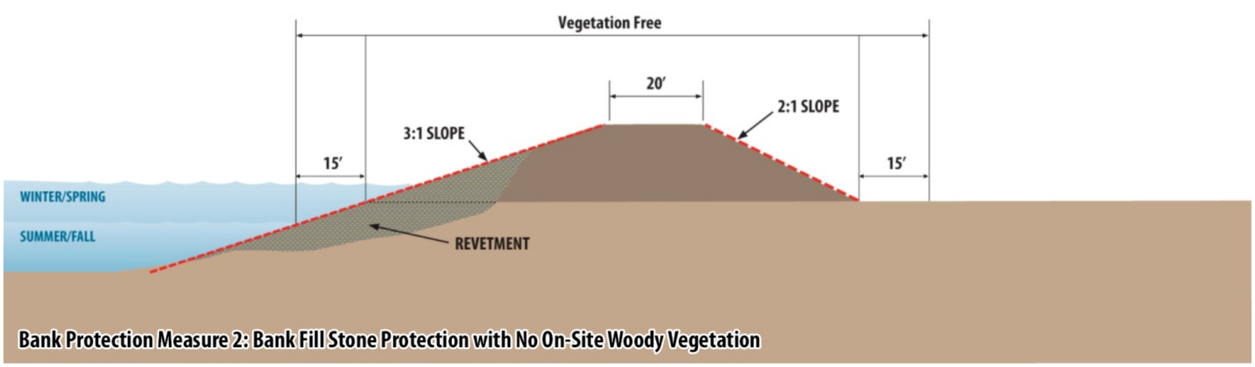
Measure 1 would be most applicable in areas where substantial habitat values exist along the channel and land uses in the setback area are not restrictive. Setback levees can be very effective, but real estate acquisition (including the need for willing sellers), existing land use, and technical issues limit opportunities for setback levees in the program area. Setback levees may offer opportunities for mitigation of riparian, bank swallow and fish habitat loss at other bank protection sites and restore riverine processes. Setback levees may also provide other flood control benefits, such as addressing seepage issues, that other bank protection measures would not address.



Bank Protection Measure 1: Setback Levee

Bank Protection Measure 2–Bank Fill Stone Protection with No On-Site Woody Vegetation:

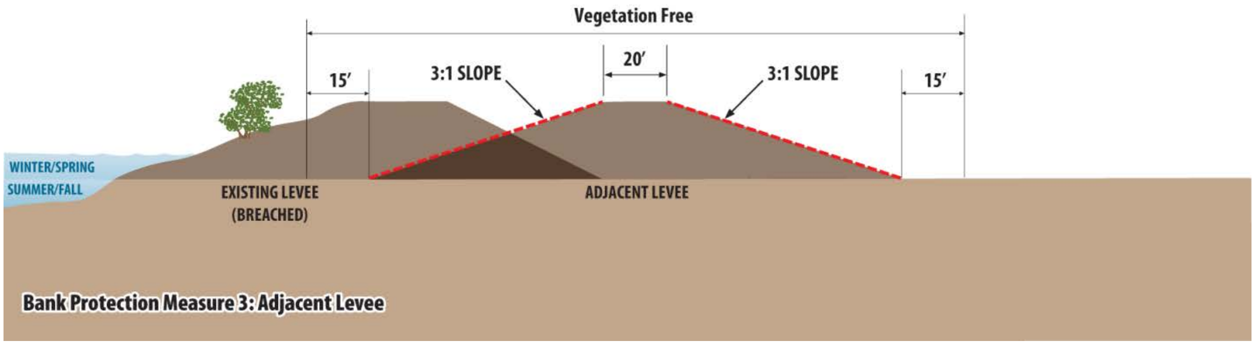
This measure, which entails filling the eroded portion of the bank and installing quarry stone along the levee slope, is needed as determined by site-specific analysis. Vegetation would be limited to native grass, and existing vegetation would be removed within the VFZ. If there is a natural bank distinct from the levee that requires erosion protection, it would be treated with revetment. Measure 2 would be most applicable in areas where there is inadequate space or substantial constraints, either landside or waterside, where hydraulic concerns would make it difficult to implement the other measures, or where existing habitat values are very limited.



Bank Protection Measure 2: Bank Fill Stone Protection with No On-Site Woody Vegetation

Bank Protection Measure 3–Adjacent Levee:

This measure involves the construction of a new levee embankment adjacent to and landward of the existing levee. The adjacent levee would be constructed to Corps design standards, which require adjacent levees to be constructed with 3:1 slopes (distance width to distance height, or dW:dH) on both the waterside and landside. The landward portion of the existing levee would be an integral, structural part of the new levee. The waterward portion of the existing levee would remain. Vegetation and instream woody material (IWM) could be placed on the old levee if that portion is outside of the VFZ. However, a variance under the Vegetation ETL may be required if the existing levee is considered to be a waterside planting berm based on its dimensions and proximity to the new levee. The existing levee may also be degraded to riparian and/or wetland benches that comply with the Corps' vegetation management policy. Measure 3 would be appropriate at many sites where waterside berms are narrow or non-existent but landside uses limit the use of a setback levee.



Bank Protection Measure 4–Riparian and Wetland Benches with Revegetation:

Measure 4 consists of three design variations presented as Measures 4a, 4b, and 4c. In general, Measure 4 involves the placement of clean quarry stone from the toe of the bank up to the summer/fall waterline and placing quarry stone and soil-filled quarry stone on the levee slope above the summer/fall waterline. While Measures 4a, 4b, and 4c would comply with the Vegetation ETL, requiring removal of all woody vegetation within the VFZ, plantings outside of the VFZ could include a variety of native tree species.

Measures 4a, 4b, and 4c vary from one another with regard to the placement and extent of environmental features that are intended to increase habitat quality (bank construction, vegetation, and IWM). These variations are driven by a number of factors, most importantly the types of existing resources and the types of species likely to use those resources. For example, if the existing site is downstream of Sacramento River Mile 30 and likely to be used by delta smelt, the new design would not include IWM below the summer/fall waterline, because IWM is not considered optimal habitat for delta smelt. New IWM would be installed downstream of RM 30 only to replace existing IWM removed during repair of the bank (1:1 ratio). Upstream of RM 30, new IWM is usually incorporated into the design because delta smelt aren't likely to be present.

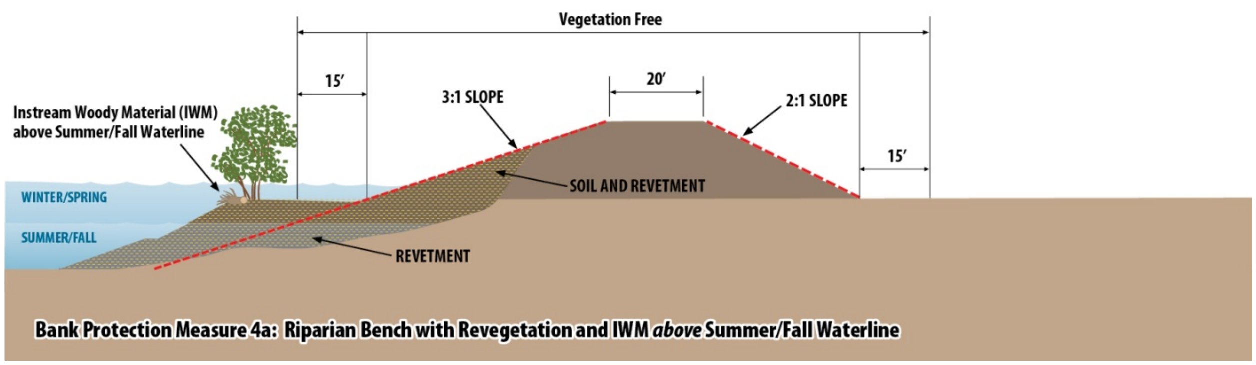
These measures are appropriate where the channel is wide enough to accommodate the installation of the stone and soil structure without substantially affecting the hydraulic capacity of the channel.

Bank Protection Measure 4a–Riparian Bench with Revegetation and Instream Woody Material above Summer/Fall Waterline

Measure 4a entails installing revetment along the waterside levee slope or bank as well as a rock/soil bench to support riparian vegetation and provide a place to anchor IWM. This design provides near-bank, shallow-water habitat and components of shaded riverine aquatic (SRA) habitat for fish and is typically applicable to sites upstream of Sacramento River Mile 30. Treatment of existing vegetation, site preparation, and installation of revetment on the lower slope would be similar to Measure 2.

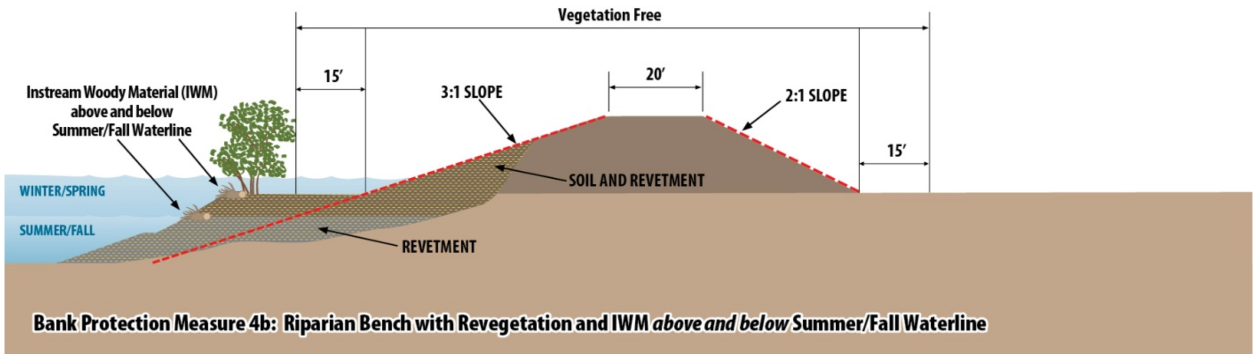
Measure 4a includes a riparian bench. The bench would be treated with soil-filled quarry stone and is intended to be inundated at river stages corresponding to high tide (where tidally influenced) or during average winter/spring flows. The riparian bench would be revegetated in compliance with the Vegetation ETL and in a manner similar to recent SRBPP projects with riparian bench designs.

The riparian bench would be constructed at a slope of 6:1 to 10:1, and the revetment portion above and below the bench would typically have a 3:1 slope. The width of the bench would be approximately 10–30 feet, depending on site conditions. Anchored IWM would be embedded on top of the riparian bench above the summer/fall waterline. The IWM would be available as accessible habitat along the banks only during winter/spring flows, when the bench is inundated.



Bank Protection Measure 4b–Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

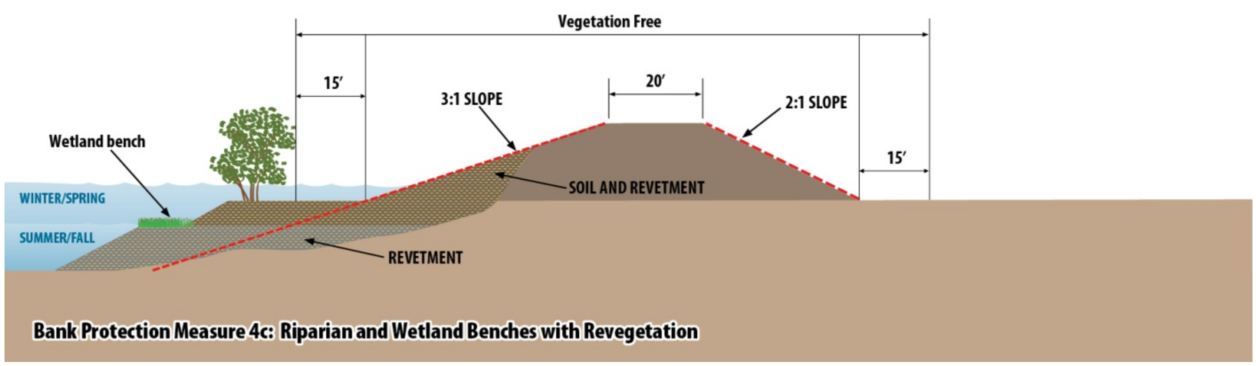
Measure 4b entails installing revetment along the waterside levee slope and/or bank as well as a rock/soil bench (as described for Measure 4a) to support riparian vegetation and provide a place to anchor IWM. IWM also would be placed beyond the bench below the summer/fall waterline, thereby increasing the types and extent of mitigation for shallow-water fish habitat, providing year-round instream habitat for targeted fish species. This design is typically applicable to sites upstream of Sacramento River Mile 30. Treatment of existing vegetation, site preparation, and installation of lower slope quarry stone would be similar to Measure 2. Installation of soil-filled quarry stone and riparian bench would be similar to Measure 4a.



Bank Protection Measure 4c–Riparian and Wetland Benches with Revegetation

Measure 4c entails installing revetment along the waterside levee slope and/or bank, as well as a rock/soil bench to support riparian vegetation and provide a place to anchor IWM. Bench slopes would be the same as those described for Measure 4a. The design also includes a wetland bench below the summer/fall waterline to further increase habitat quality. This design is intended for sites downstream of Sacramento River Mile 30 and targets mitigation of impacts on delta smelt habitat. Existing vegetation would be removed within the VFZ. Because IWM might increase habitat suitability of ambush predators, new IWM would be installed only to replace existing IWM removed during project repair (1:1 ratio).

The riparian and wetland benches are intended to flood at river stages corresponding to winter/spring (high) flows and summer/fall (low) flows, respectively. Both benches would be revegetated in compliance with the Vegetation ETL.

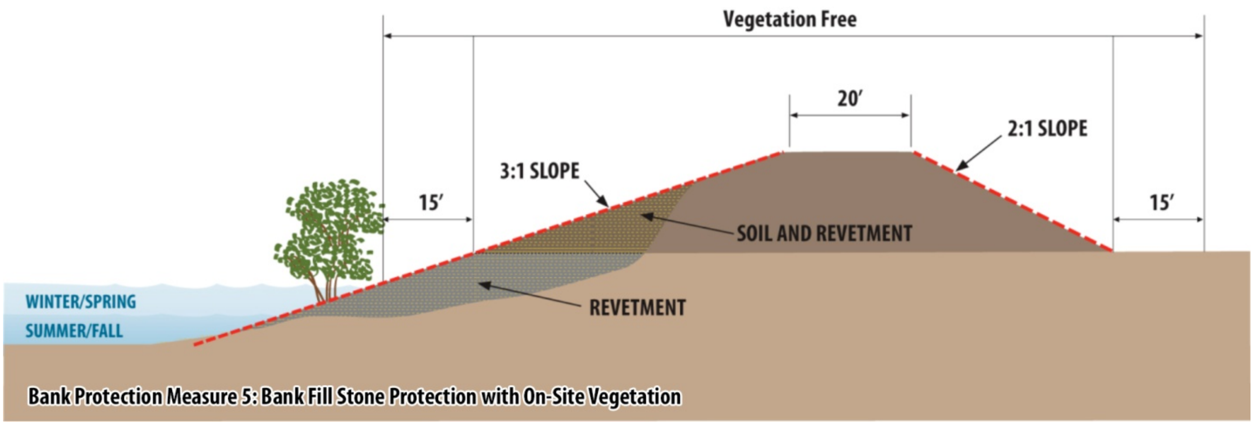


Bank Protection Measure 5–Bank Fill Stone Protection with On-Site Vegetation:

Measure 5 entails filling the eroded portion of the bank and installing revetment along the waterside levee slope and streambank from streambed to a height determined by site-specific analysis. The revetment would be placed at a slope of 3:1. All IWM would be removed from the bank and would not be replaced on the bank fill stone protection.

Existing vegetation would be removed within the VFZ; however, grass would be allowed in this area. Approximately 25% of existing vegetation that is outside of the VFZ on the waterside slope is estimated to be retained during construction, although the actual amount of retained vegetation could vary substantially from site to site. New vegetation would be limited to native grasses within the VFZ, while woody vegetation could be replaced by planting outside of the VFZ, as allowed by site-specific conditions. The long-term goal of vegetation planting is to provide riparian and SRA cover habitat as defined by the U.S. Fish and Wildlife Service (USFWS). If there is a natural bank distinct from the levee that requires erosion protection, it would be treated with revetment.

Similar to Measure 2, Measure 5 would be most applicable in areas where there is inadequate space or substantial constraints that would limit the applicability of the other measures. However, some amount of space to allow for the planting of vegetation is necessary.



Bank Protection Measure 5: Bank Fill Stone Protection with On-Site Vegetation

Additional Measures

Additional measures may be considered and found to be appropriate during implementation of the site-specific repairs. Design and analysis of any additional measures would be carried out during the site-specific planning and design phase. Examples of additional measures include toe protection, flow modification (e.g., impermeable groins) and alternative materials in place of riprap.

Toe Protection

Toe protection is authorized by SRBPP and could be considered for long-term erosion control. Toe protection entails filling the low-lying eroded portion of the bank to curtail further loss of the toe and subsequent losses of the upper bank typically resulting from toe erosion. Because toe protection doesn't replace existing losses of material on the upper bank, which is often the condition at critical sites, it is not considered a complete solution for critical sites. Consequently, toe protection has not been implemented recently because many erosion sites are considered to be at or near critical.

Flow Modification

Groins, or spurs, redirect or reduce erosive forces along the channel bank by diverting the stronger currents and deflecting water away from the bank. By deflecting the current away from the bank and causing sediment deposits, a spur or a series of spurs may protect the streambank more effectively and at a lower cost than revetment. Spurs are also used to channelize a wide, poorly defined stream into a well-defined channel that neither aggrades nor degrades, thus maintaining its location from year to year. Spurs on streams with suspended sediment induce sedimentation to establish and maintain the new alignment. Dikes fall in the category of an erosion control or flow diversion structure extending roughly perpendicular from a streambank that either diverts flow from the bank or reduces flow velocity adjacent to the bank. Flow diversion also can be accomplished through biotechnical methods in some locations. For example, log brush barriers are densely packed layers of branches and logs that divert stream flow from an eroding bank.

A bendway weir is an upstream-angled underwater sill. Water flowing over the weir is redirected at an angle perpendicular to the weir. When weirs are angled upstream, water is directed away from the outer bank and toward the inner part of the bend, breaking up the river's strong secondary currents. Weirs are typically built in sets (4 to 14 weirs per bend) and are designed to redirect current directions and velocities through the bend and well into the downstream crossing.

Alternative Materials and Construction Methods

Reinforced Soil Slopes and Mechanically Stabilized Earth Walls

Mechanically stabilized earth walls (MSEWs) are internally-reinforced soil structures with faces angled 70 degrees to 90 degrees from horizontal. Structures with slope angles less than 70 degrees are termed reinforced soil slopes (RSSs).

MSEWs and RSSs use soil and rock with structural elements, such as geogrids, to provide for steeper stable slopes than typically occur naturally. These structures provide long-term stability yet can be porous enough to provide filtration and support vegetated growth. Vegetated MSEW and RSS structures can become stronger as root systems penetrate and grow throughout the retained mass, providing a long-term vegetated solution for erosion and soil retention issues. The engineered MSEWs and RSSs remain to provide stability during the time it takes vegetation to become established, as well as into the long term. The advantage of these structures is a more natural appearance in areas with limited rights-of-ways or unacceptable encroachment within the channel compared with some other repair methods.

Artificial Floating Structures

Artificial floating structures are modeled after natural floating islands formed when floating vegetation grows and accumulates gas, or nutrient rich peat soil becomes buoyant, rises to the surface, and is colonized by plants. Artificial floating structures are made of a recycled nontoxic plastic mesh injected with marine foam for initial buoyancy. Artificial floating structures can be used to enhance fish habitat by simulating submerged, vegetated undercut banks and providing overhead shaded cover. The resulting underwater root structure may provide important habitat, including forage, refuge from predators, spawning substrate, and brood cover for many fish species. However, the potential for increased predation associated with artificial floating structures is not well understood. Artificial floating structures might be useful in absorbing wave and wake energy, modifying flows and hydraulic processes, complementing shoreline restoration, and providing shallow water habitat. Artificial floating structures might be useful and practical in the Delta along river banks where the current is not strong.

Alternatives

Alternatives Development

Consistent with NEPA and CEQA, a reasonable range of alternatives that would meet the project purpose and need, while avoiding or substantially lessening project effects (as required under CEQA), was evaluated. To comply with NEPA, this EIS/EIR analyzes all alternatives at the program level on an equal, non-preferential basis and at an equal level of detail. As required under NEPA and CEQA, a no action (no project) alternative has been included to allow the Lead Agencies to compare the effects of the proposed alternatives with the effects of taking no action.

The alternatives were developed using those bank protection measures considered to reasonably meet the project's purpose, need, and objectives. Alternatives development also took into consideration an alternative's ability to eliminate significant adverse environmental impacts or reduce them to less-than-significant levels, as well as minimize any contribution to cumulative impacts.

In addition to the no action alternative, five action alternatives, as well as a sub-alternative of each action alternative, are analyzed. The five action alternatives would apply a site-specific bank protection measure (design solution) to each of the 106 sites. In general, selection of bank protection measures at specific sites is based on consideration of the likely causes of erosion, local conditions that could impact repair and construction, and site-specific considerations for vegetation, wildlife, land ownership, and access. The site-specific bank protection measure applied to each site may vary from one alternative to another. For example, a setback levee may be applied to an erosion site under one alternative, while a bench alternative may be applied to that same site under a different alternative. These variations allow for meeting the objectives of each alternative (e.g., minimizing impacts).

For bank protection measures to be feasible, they must comply with the Corps's Vegetation ETL (U.S. Army Corps of Engineers 2014). The key aspect of the Vegetation ETL that is relevant to the development of feasible alternatives is its requirement for a VFZ surrounding all levees and appurtenant structures. The VFZ must be free of obstructions to ensure access by personnel and equipment for surveillance, inspection, maintenance, monitoring, and flood-fighting. A secondary purpose is to provide a distance between root systems and levees to moderate reliability risks associated with 1) piping and seepage, and 2) structural damage (e.g., wind-driven tree overturning). However, the Vegetation ETL does provide for the use of a variance which, when justified, allows for some vegetation to remain within the VFZ. Alternative 6 includes variations of the previously described bank protection measures in that there is sometimes vegetation within the VFZ. As a result, Alternative 6 would rely on a variance to the Vegetation ETL.

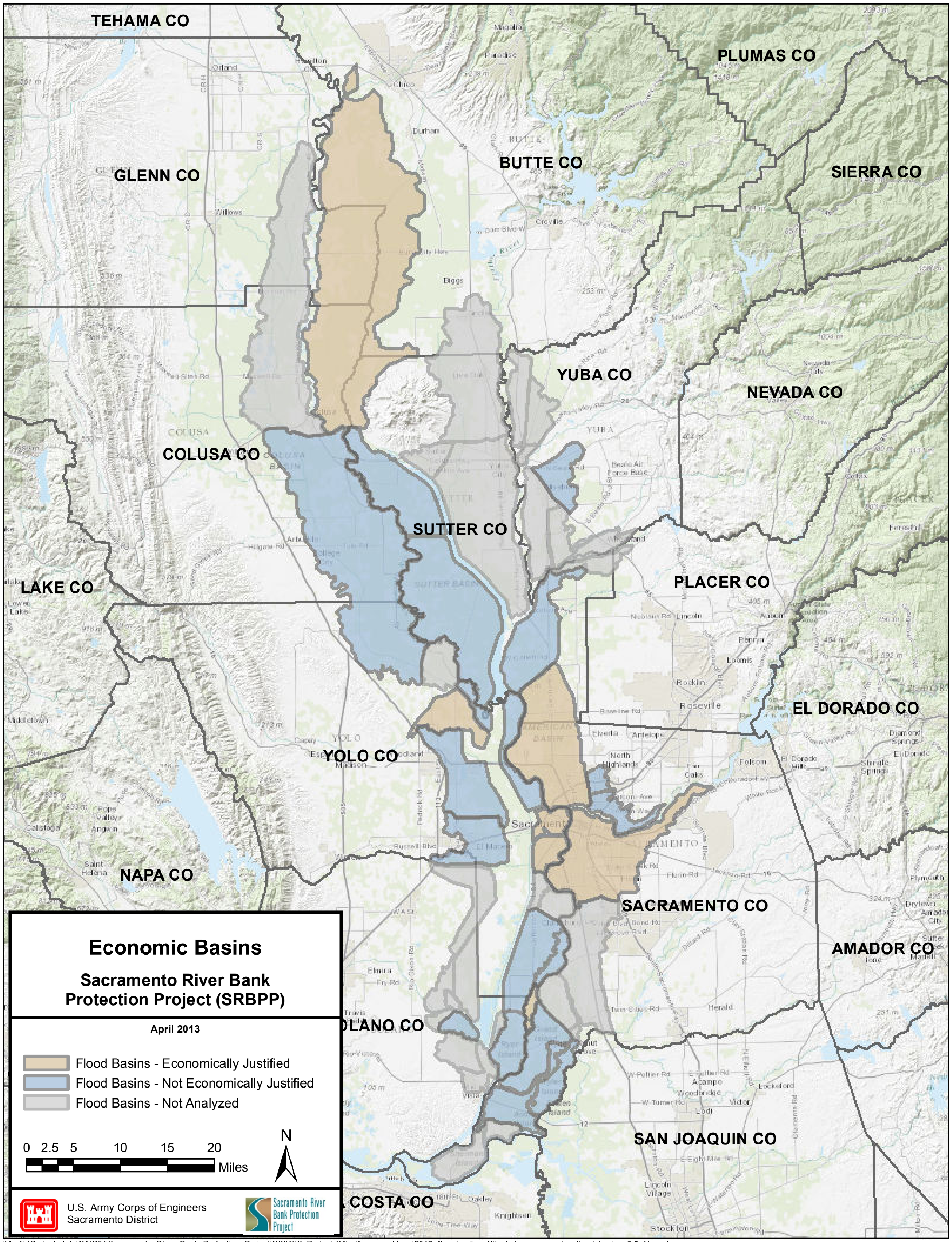
All of the alternatives described below could be implemented in a variety of ways. Examples of potential implementation strategy variables are listed below.

- Annual construction rate.
- Annual geographic distribution (e.g., sites distributed among more than one region, all sites within one region/basin.
- Use of off-site/out-of-kind mitigation that contributes to listed species recovery.

Additionally, implementation may be influenced by a benefit-cost analysis. In accordance with Corps policy, all water resources projects must have a federal interest and be justified by showing beneficial outputs greater than costs. While the traditional approach has been to look at the erosion sites in the aggregate (e.g., all 106 sites together), and that approach will likely continue, economic flood damages within individual basins or reclamation districts, maintenance areas, or levee districts would be a priority consideration in site selection.

A preliminary analysis has indicated that flood damage reduction in certain less-developed regions in the program area that are primarily agricultural with fewer damageable structures are not likely to meet the economic benefit-cost criterion. During the implementation phase, it may be difficult to justify bank protection for levees that protect these regions. In these areas, bank protection may be justified where there is a substantial risk to life safety. Risk to public safety can also be managed in these areas through other means such as the Public Law 84-99 Rehabilitation and Inspection Program, which allows the Corps to undertake activities including advance measures, emergency operations, and rehabilitation of flood control works threatened or destroyed by floods. Accordingly, this EIS/EIR considers a set of sub-alternatives within these "economically justified basins." A subset of the 106 sites is analyzed under each action alternative. The subset, or sub-alternative, represents the erosion sites within seven basins that are most likely to satisfy the more restrictive approach to the benefit-cost analysis (Figure ES-2). Table ES-1 identifies the specific bank protection measures assigned to each of the 106 sites, and includes a notation for the subset of erosion sites that are within the economically justified basins. Figures ES-3 through ES-7 show the distribution of the specific bank protection measures for each of the action alternatives.

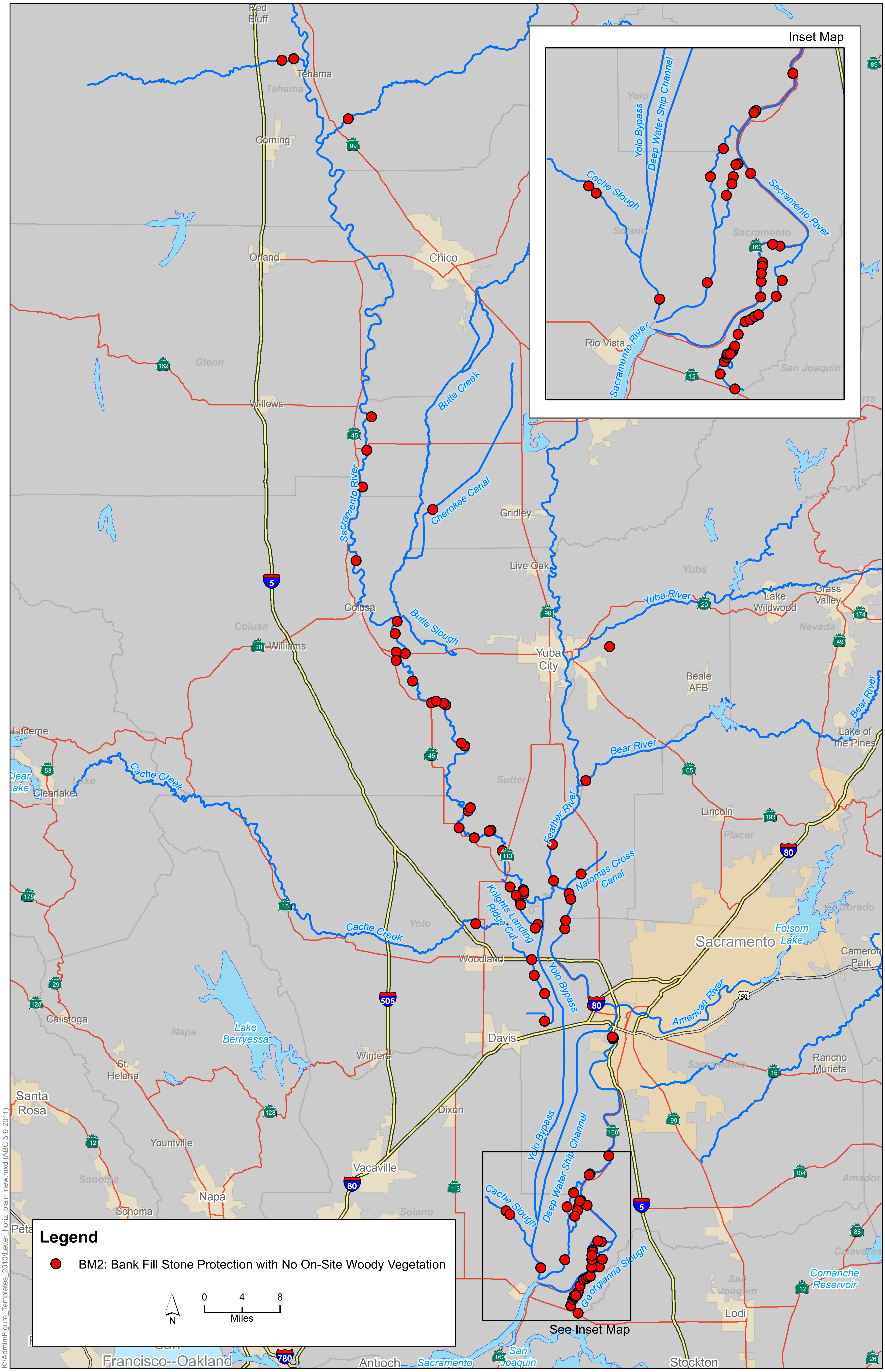
Following Table ES-1 is a general description of the six alternatives, which consist of the no action alternative, and five action alternatives and their sub-alternatives.



Source: USACE 2013.

Graphics/Projects/06207.08 Sac Bank/EIS/EIR (06-13) SS

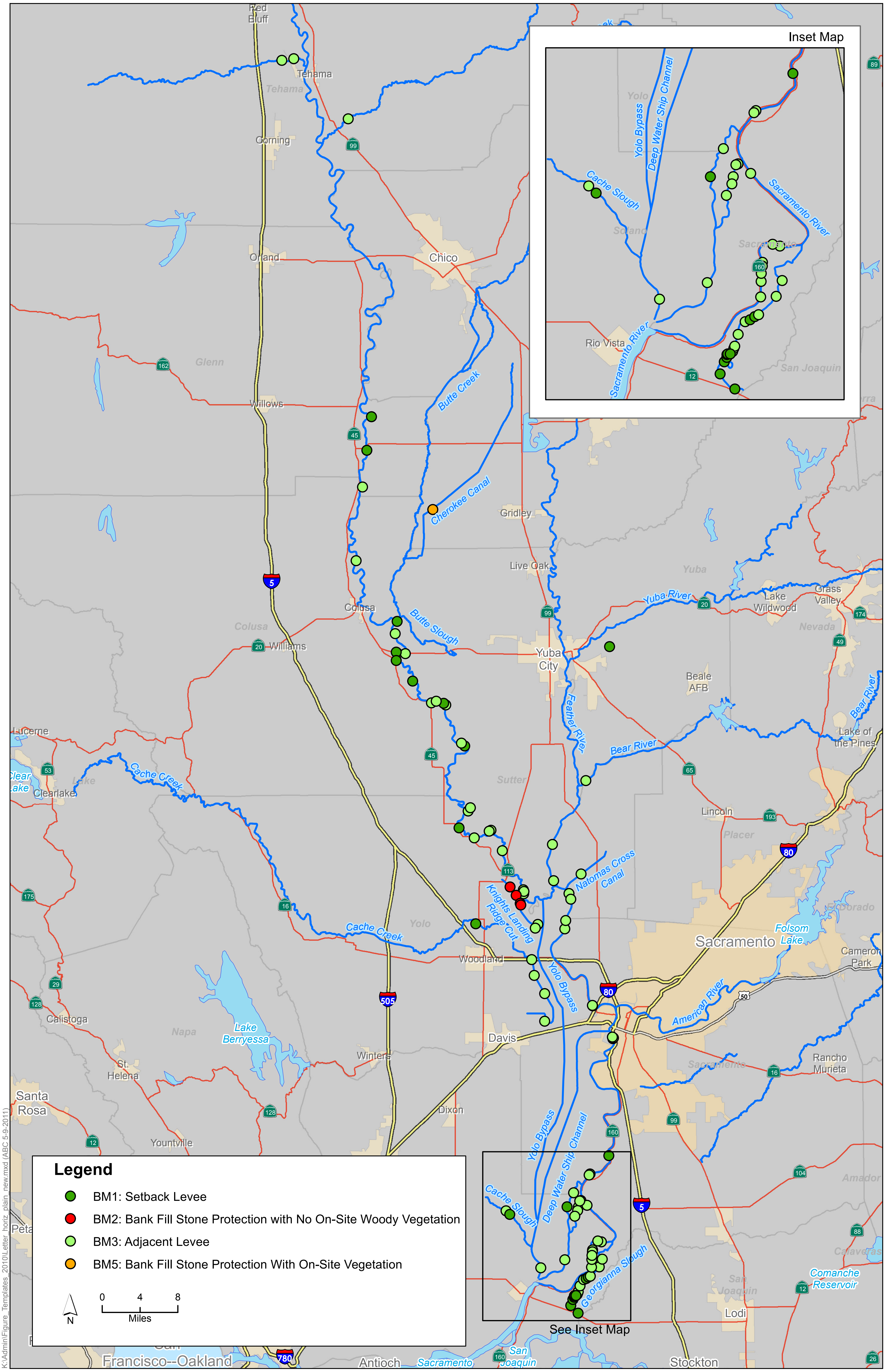
Figure ES-2
Location of Economically Justified Basins



K:\Admin\Figure_Templates_2010\Letter_horiz_plain_new.mxd (ABC 5-9-2011)

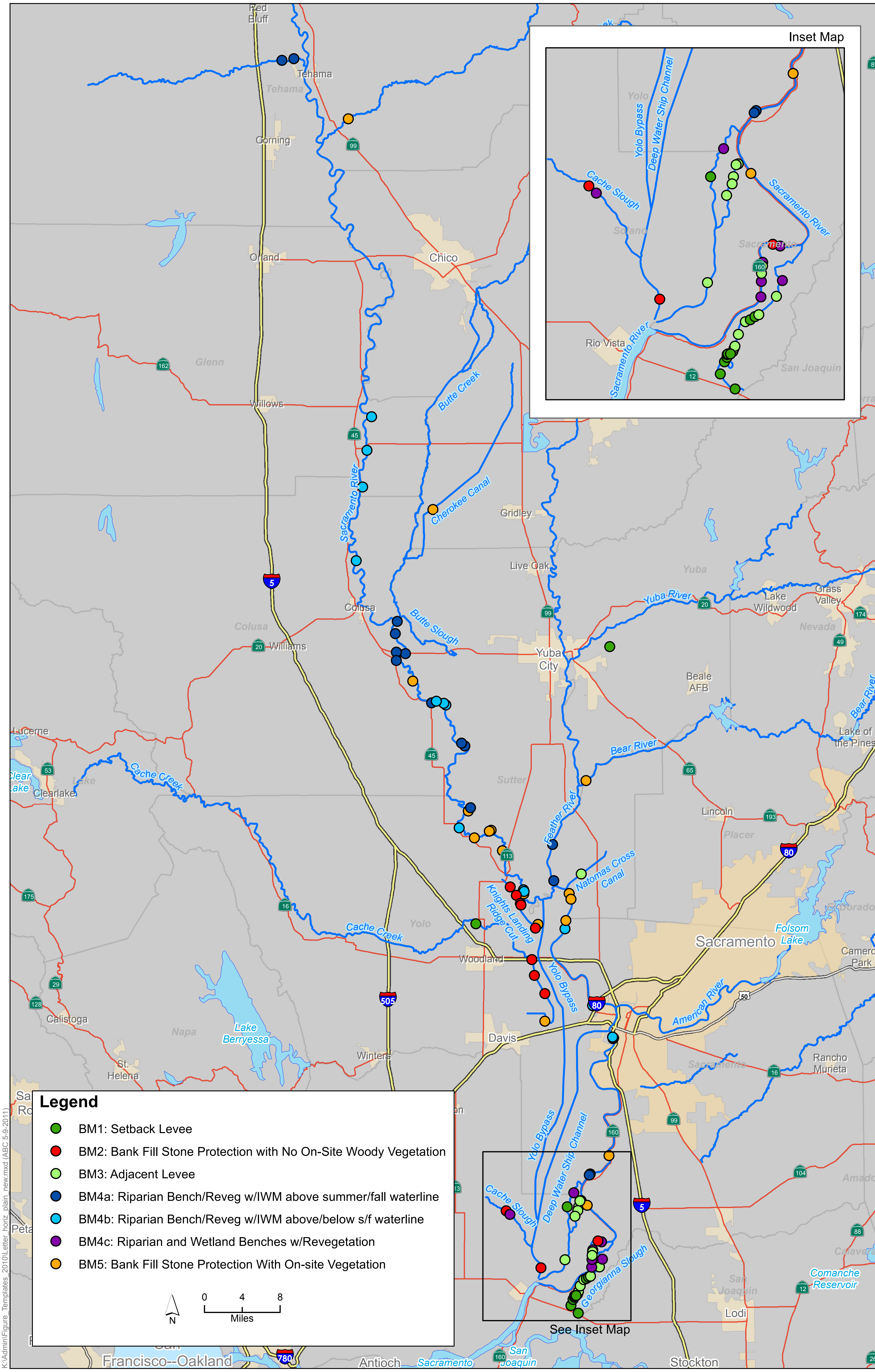
ICF INTERNATIONAL

Figure ES-3
Site-Specific Application of Bank Protection Measures for Alternative 2



ICF INTERNATIONAL

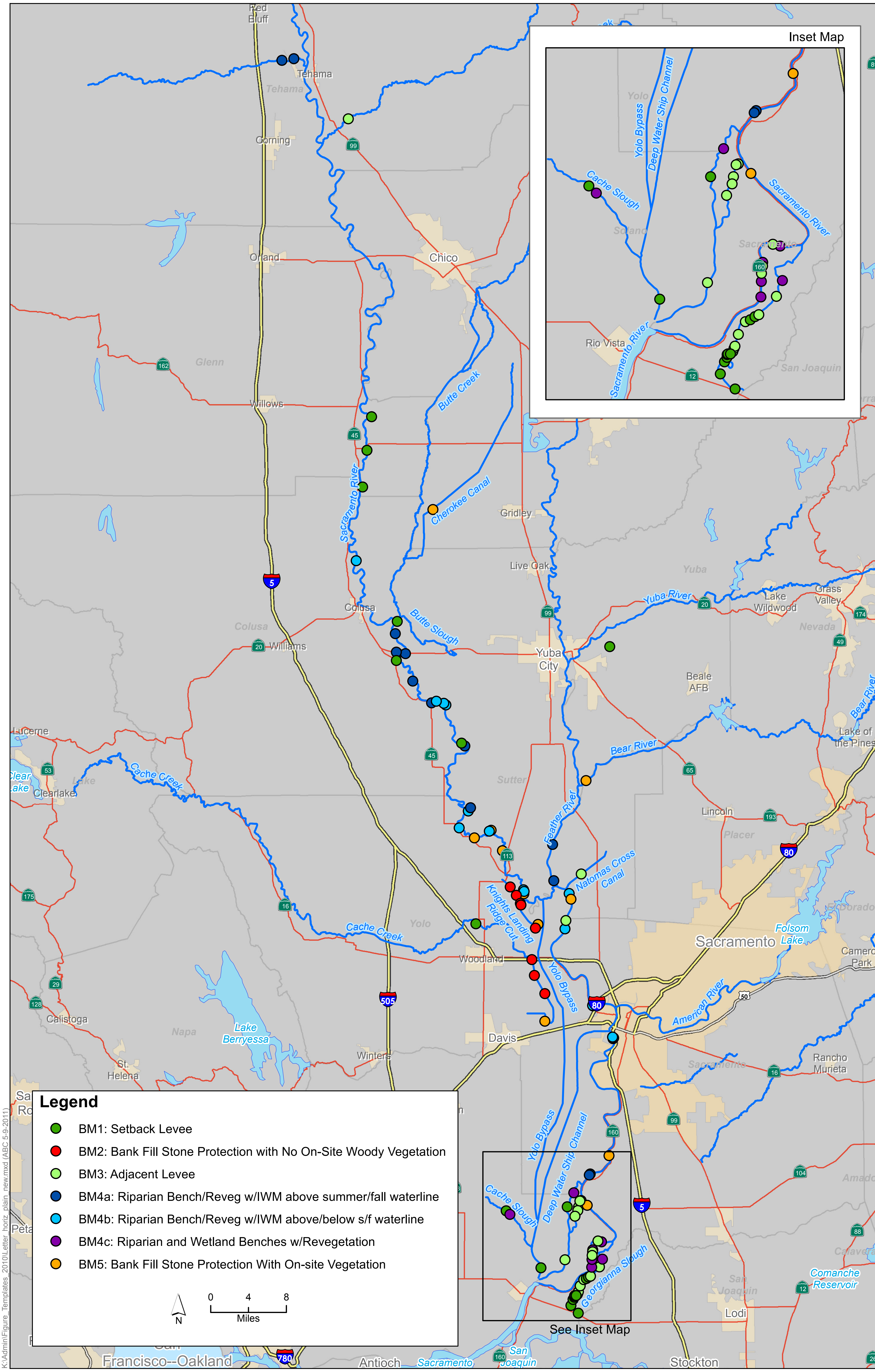
Figure ES-4
Site-Specific Application of Bank Protection Measures for Alternative 3



K:\Admin\Figure_Templates_2010\Letter_horiz_plain_new.mxd (ABC 5-9-2011)

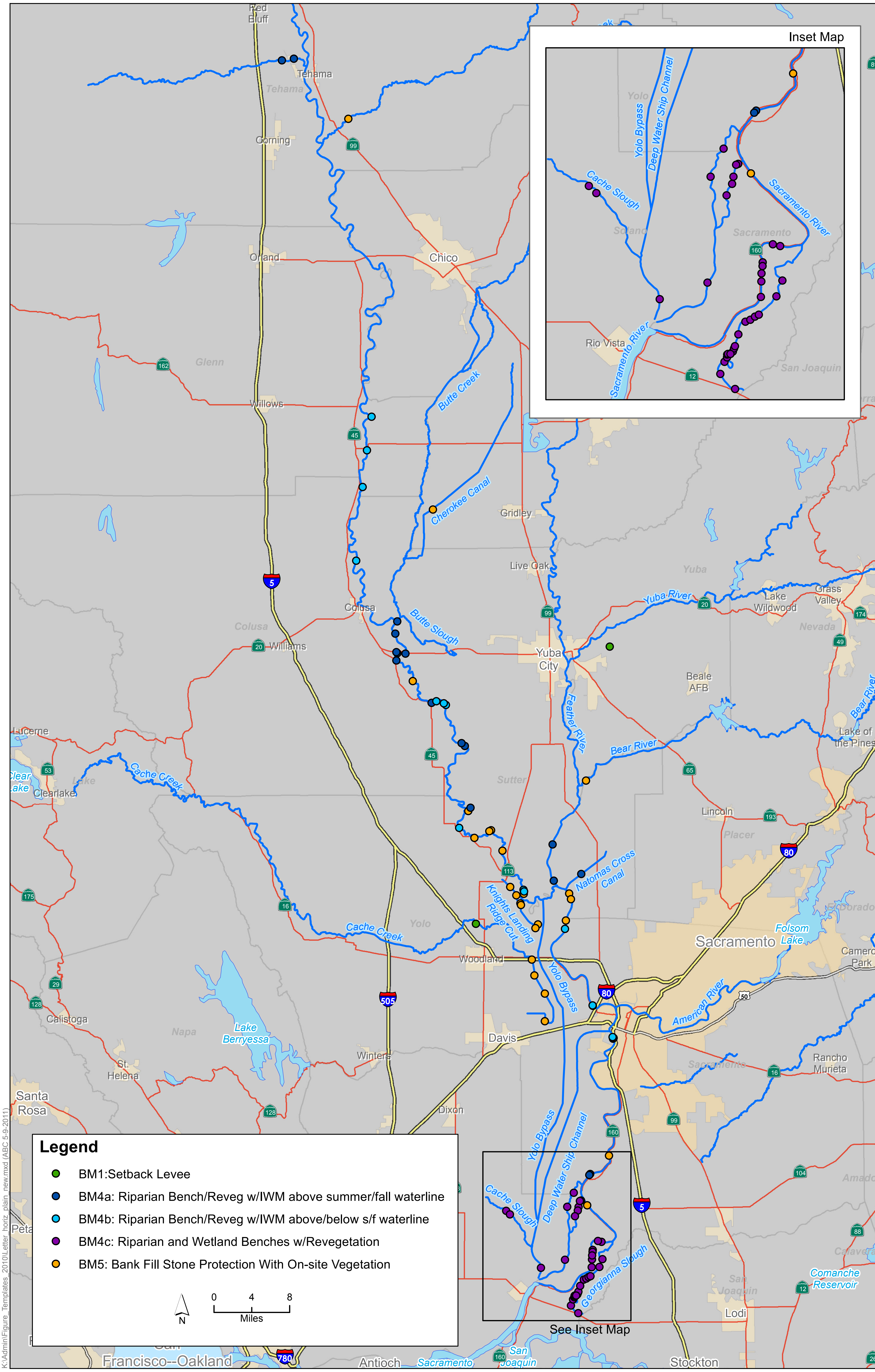
ICF INTERNATIONAL

Figure ES-5
Site-Specific Application of Bank Protection Measures for Alternative 4



K:\Admin\Figure_Templates_2010\Letter_horiz_plain_new.mxd (ABC 5-9-2011)

Figure ES-6
Site-Specific Application of Bank Protection Measures for Alternative 5



ICF INTERNATIONAL

Figure ES-7
Site-Specific Application of Bank Protection Measures for Alternative 6

Table ES-1. Site-Specific Application of Bank Protection Measures by Alternative

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1a+	Cache Creek	LM	3.9	L	433	2	2	1	1	1	1	1	1	1	1
1a	Cache Slough	RM	15.9	L	182	2		3		2		1		4c	
1a	Cache Slough	RM	22.8	R	630	2		1		4c		4c		4c	
1a	Cache Slough	RM	23.6	R	1,209	2		3		2		1		4c	
1a	Deep Water Ship Channel	LM	5.0	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Deep Water Ship Channel	LM	5.01	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Georgiana Slough	RM	0.3	L	1,027	2		1		1*		1		4c	
1a	Georgiana Slough	RM	1.7	L	1,250	2		1		1*		1		4c	
1a	Georgiana Slough	RM	2.5	L	736	2		1		1*		1		4c	
1a	Georgiana Slough	RM	3.6	L	1,364	2		1		1*		1		4c	
1a	Georgiana Slough	RM	3.7a	L	209	2		1		1*		1		4c	
1a	Georgiana Slough	RM	3.7b	L	268	2		1		1*		1		4c	
1a	Georgiana Slough	RM	4.0	L	705	2		1		1*		1		4c	
1a	Georgiana Slough	RM	4.3	L	1,319	2		3		3*		3		4c	
1a	Georgiana Slough	RM	4.5	L	90	2		3		3*		3		4c	
1a	Georgiana Slough	RM	4.6	L	1,346	2		3		3*		3		4c	
1a	Georgiana Slough	RM	5.3	L	3,171	2		3		3*		3		4c	
1a	Georgiana Slough	RM	6.1	L	1,729	2		3		3		3		4c	

Bank Protection Measures Legend

N/A: No Action
1: Setback Levee
2: Bank Fill Stone Protection with No On-Site Woody Vegetation
3: Adjacent Levee
4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline
4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline
4c: Riparian and Wetland Benches with Revegetation
5: Bank Fill Stone Protection with On-Site Vegetation

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1a	Georgiana Slough	RM	6.4	L	398	2		1		1*		1		4c	
1a	Georgiana Slough	RM	6.6	L	744	2		1		1*		1		4c	
1a	Georgiana Slough	RM	6.8	L	1,335	2		1		3		3		4c	
1a	Georgiana Slough	RM	8.3	L	483	2		3		3		3		4c	
1a	Georgiana Slough	RM	9.3	L	1,228	2		3		4c		4c		4c	
1a+	Knights Landing Ridge Cut	LM	0.2	R	768	2	2	3	3	2	2	2	2	5	5
1a	Knights Landing Ridge Cut	LM	3.0	L	1,279	2		2		2		2		5	
1a	Knights Landing Ridge Cut	LM	3.1	L	368	2		2		2		2		5	
1a	Knights Landing Ridge Cut	LM	4.3	L	577	2		2		2		2		5	
1a	Knights Landing Ridge Cut	LM	5.3	L	8,564	2		2		2		2		5	
1a	Steamboat Slough	RM	18.8	R	485	2		3		3		3		4c	
1a	Steamboat Slough	RM	23.2	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a+	Steamboat Slough	RM	23.9	R	369	2	2	3	3	3	3	3	3	4c	4c
1a+	Steamboat Slough	RM	24.7	R	911	2	2	3	3	3	3	3	3	4c	4c
1a	Steamboat Slough	RM	25.0	L	272	2		3		3		3		4c	
1a+	Steamboat Slough	RM	25.8	R	244	2	2	3	3	3	3	3	3	4c	4c
1a	Steamboat Slough	RM	26.0	L	516	2		3		3		3		4c	
1a	Sutter Slough	RM	24.7	R	1,736	2		1		1		1		4c	
1a+	Sutter Slough	RM	26.5	L	568	2	2	3	3	4c	4c	4c	4c	4c	4c

Bank Protection Measure Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1a	Willow Slough	LM	0.2	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Willow Slough	LM	0.7	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Willow Slough	LM	6.9	R	869	2		3		2		2		5	
1a	Yolo Bypass	LM	0.1	R	430	2		3		2		2		5	
1a	Yolo Bypass	LM	2.0	R	563	2		3		2		2		5	
1a	Yolo Bypass	LM	2.5	R	148	2		3		5		5		5	
1a	Yolo Bypass	LM	2.6	R	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Yolo Bypass	LM	3.8	R	1,860	2		3		2		2		5	
1b	Lower American River	RM	7.3	R	N/A	N/A		N/A		N/A		N/A		N/A	
1b	Sacramento River	RM	21.5	L	162	2		3		4c		4c		4c	
1b	Sacramento River	RM	22.5	L	852	2		3		4c		4c		4c	
1b	Sacramento River	RM	22.7	L	309	2		3		3		3		4c	
1b	Sacramento River	RM	23.2	L	589	2		3		3		3		4c	
1b	Sacramento River	RM	23.3	L	257	2		3		4c		4c		4c	
1b	Sacramento River	RM	24.8	L	782	2		3		2		3		4c	
1b	Sacramento River	RM	25.2	L	338	2		3		4c		4c		4c	
1b	Sacramento River	RM	31.6	R	446	2		3		5		5		5	
1b**	Sacramento River	RM	35.3	R	197	2		3		4a		4a		4a	
1b**	Sacramento River	RM	35.4	R	96	2		3		4a		4a		4a	

Bank Protection Measure Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1b	Sacramento River	RM	38.5	R	359	2		1		5		5		5	
1b+	Sacramento River	RM	56.5	R	373	2	2	3	3	4b	4b	4b	4b	4b	4b
1b+	Sacramento River	RM	56.6	L	86	2	2	3	3	4a	4a	4a	4a	4a	4a
1b+	Sacramento River	RM	56.7	R	665	2	2	3	3	4b	4b	4b	4b	4b	4b
1b+***	Sacramento River	RM	58.4	L	707	2	2	3	3	5	5	5	5	5	5
1b+	Sacramento River	RM	60.1	L	455	2	2	3	3	4a	4a	3	3	4a	4a
1b+	Sacramento River	RM	62.9	R	175	2	2	3	3	4b	4b	4b	4b	4b	4b
1b+	Sacramento River	RM	63.0	R	87	2	2	3	3	4b	4b	4b	4b	4b	4b
1b	Sacramento River	RM	74.4	R	200	2		3		4b		4b		4b	
1b	Sacramento River	RM	75.3	R	2,761	2		3		5		3		5	
1b	Sacramento River	RM	77.7	R	224	2		3		5		5		5	
1b+	Sacramento River	RM	78.3	L	657	2	2	3	3	5	5	4b	4b	5	5
2	Bear River	RM	0.8	L	233	2		3		5		5		5	
2	Cherokee Canal	LM	14.0	L	N/A	N/A		N/A		N/A		N/A		N/A	
2	Cherokee Canal	LM	21.9	L	1,800	2		5		5		5		5	
2	Feather River	RM	0.6	L	288	2		3		4a		4a		4a	
2	Feather River	RM	5.0	L****	910	2		3		4a		4a		4a	
2	Sacramento River	RM	86.3	L	3,134	2		3		5		5		5	
2**	Sacramento River	RM	86.5	R	72	2		3		4b		4b		4b	

Bank Protection Measure Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
2	Sacramento River	RM	86.9	R	289	2		3		4b		4b		4b	
2	Sacramento River	RM	92.8	L	200	2		3		5		5		5	
2	Sacramento River	RM	95.8	L	190	2		3		5		5		5	
2	Sacramento River	RM	96.2	L	560	2		3		5		4b		5	
2	Sacramento River	RM	99.0	L	160	2		3		5		5		5	
2	Sacramento River	RM	101.3	R	352	2		1		4b		4b		4b	
2	Sacramento River	RM	103.4	L	N/A	2		N/A		N/A		N/A		N/A	
2	Sacramento River	RM	104.0	L	3,459	2		3		5		4b		5	
2	Sacramento River	RM	104.5	L	301	2		3		4a		4a		4a	
2	Sacramento River	RM	116.0	L	612	2		1		4a		4a		4a	
2	Sacramento River	RM	116.5	L	2,465	2		3		4a		1		4a	
2	Sacramento River	RM	122.0	R	248	2		3		4b		4b		4b	
2	Sacramento River	RM	122.3	R	341	2		1		4b		4b		4b	
2	Sacramento River	RM	123.3	L	208	2		3		4b		4b		4b	
2	Sacramento River	RM	123.7	R	120	2		3		4a		4a		4a	
2	Sacramento River	RM	127.9	R	801	2		1		5		4a		5	
2	Sacramento River	RM	131.8	L	339	2		1		4a		1		4a	
2	Sacramento River	RM	132.9	R	363	2		1		4a		4a		4a	
2	Sacramento River	RM	133.0	L	1,291	2		3		4a		4a		4a	

Bank Protection Measure Legend
N/A: No Action
1: Setback Levee
2: Bank Fill Stone Protection with No On-Site Woody Vegetation
3: Adjacent Levee
4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline
4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline
4c: Riparian and Wetland Benches with Revegetation
5: Bank Fill Stone Protection with On-Site Vegetation

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
2	Sacramento River	RM	133.8	L	197	2		3		4a		4a		4a	
2	Sacramento River	RM	136.6	L	615	2		3		4a		4a		4a	
2	Sacramento River	RM	138.1	L	1,365	2		1		4a		1		4a	
2	Yuba River	LM	2.3	L	1,356	2		1		1		1		1	
3	Deer Creek	LM	2.4	L	496	2		3		5		3		5	
3	Elder Creek	LM	1.44	L	334	2		3		4a		4a		4a	
3	Elder Creek	LM	3.0	R	65	2		3		4a		4a		4a	
3	Elder Creek	LM	4.1	L	N/A	N/A		N/A		N/A		N/A		N/A	
3+	Sacramento River	RM	152.8	L	198	2	2	3	3	4b	4b	4b	4b	4b	4b
3+	Sacramento River	RM	163.0	L	1,213	2	2	3	3	4b	4b	1	1	4b	4b
3+	Sacramento River	RM	168.3	L	546	2	2	1	1	4b	4b	1	1	4b	4b
3+	Sacramento River	RM	172.0	L	525	2	2	1	1	4b	4b	1	1	4b	4b

+ Site is located within an economically justified basin.

* Design (setback or adjacent levee) combined with adjacent sites.

** Sacramento River 35.3R, 35.4R, and 86.5R have been repaired.

*** Though Sacramento River 58.4L is not a currently inventoried erosion site, nor has it ever been, it constitutes a representative site for the purposes of the programmatic SAM and EIS/EIR analyses. As previously described, additional project-level environmental documentation, tiering from this programmatic analysis, will be prepared to address those sites that will be constructed.

**** Feather River 5.0L was mistakenly called Feather River 4.9L in previous documents.

LM = levee mile; RM = river mile; L = left bank; R = right bank.

Bank Protection Measure Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Alternative 1–No Action

Under the No Action Alternative, regular operation and maintenance (O&M) of the levee system would continue as presently executed by the local maintaining entities in accordance with the existing governing O&M manual, but the Corps would not implement bank protection along SRFCP levees. The result is likely to be the continued gradual or sporadic loss of remnant floodplain (berm) and the riparian vegetation it supports, and ultimately the erosion could encroach into the cross section of the levee foundation, creating critical erosion sites. It is possible that federal or state flood control agencies or local maintaining agencies eventually would implement bank protection at various sites along SRFCP levees through emergency action. In any case, the risk of levee failure and possibly catastrophic flooding would increase substantially as more erosion sites become critical and repair is limited to emergency response. Continued erosion prior to the federal or state action would result in short- and long-term losses of valuable habitat. Although some erosion is natural, the channelization of project reaches increases erosive forces.

Alternative 2A–Low Maintenance

Alternative 2A applies Bank Protection Measure 2: Bank Fill Stone Protection with No On-Site Woody Vegetation to all 106 sites. This alternative utilizes the simplest engineering design and would rely almost exclusively on off-site mitigation.

Sub-Alternative 2B–Low Maintenance within Economically Justified Basins

Sub-Alternative 2B applies Bank Protection Measure 2: Bank Fill Stone Protection with No On-Site Woody Vegetation to 18 sites within the seven economically justified basins.

Alternative 3A–Maximize Meander Zone

Alternative 3A applies Bank Protection Measure 1: Setback Levee or Bank Protection Measure 3: Adjacent Levee to all 106 sites. This alternative minimizes instream construction and would rely heavily on on-site mitigation, potentially creating a surplus of mitigation credit. The Setback Levee measure is applied unless there are substantial constraints that limit the effectiveness or feasibility of that measure, in which case the Adjacent Levee measure is applied. Examples of limited effectiveness or feasibility include floodplain elevations or soil conditions that are not suitable for habitat restoration, hydraulic constraints (e.g., the measure would adversely affect flow splits), or the presence of substantial existing development. The Adjacent Levee measure would be applied in these situations. Table ES-1 identifies the specific bank protection measures assigned to each site.

Sub-Alternative 3B–Maximize Meander Zone within Economically Justified Basins

Sub-Alternative 3B applies Bank Protection Measure 1: Setback Levee or Bank Protection Measure 3: Adjacent Levee to 18 sites within the seven economically justified basins. Table ES-1 identifies the specific bank protection measures assigned to each site.

Alternative 4A–Habitat Replacement

Alternative 4A applies a combination of site-specific bank protection measures (Bank Protection Measures 1–5), and utilizes the bank protection measures recommended in the Final Alternatives Report to the extent that they comply with the Vegetation ETL (Kleinfelder-Geomatrix 2009). Some sites would not be compliant with the Vegetation ETL if the bank protection measures recommended in the Final Alternatives Report were applied. These particular sites were reevaluated and compliant bank protection measures were then applied. Factors taken into account in application of bank protection measures to non-compliant sites included general planning and engineering issues as well as habitat, hydraulic, and land use considerations. Off-site mitigation may be acceptable on a site-specific basis provided that the mitigation compensates for the values being lost, and mitigation is provided within the region of impact (i.e., 1a, 1b, 2, or 3). This alternative utilizes the approach taken over the last decade, which primarily focused on the re-creation of streambank habitats through the use of constructed benches with riparian vegetation, but makes adjustments to account for implementation of the Vegetation ETL. The adjustments result in an increased use of setback and adjacent levees. Table ES-1 identifies the specific bank protection measures assigned to each site.

Sub-Alternative 4B–Habitat Replacement within Economically Justified Basins

Sub-Alternative 4B applies a combination of site-specific bank protection measures to 18 sites within the seven economically justified basins. Table ES-1 identifies the specific bank protection measures assigned to each site.

Alternative 5A–Habitat Replacement Reaching Environmental Neutrality

Alternative 5A is similar to Alternative 4 in that it relies on the Final Alternatives Report's recommended bank protection measures and modifies those that were not Vegetation ETL compliant. Alternative 5 differs in that it minimizes the use of off-site mitigation through the application of fewer site-specific bank protection measures that result in adverse habitat effects. Alternative 5 builds on the analysis of Alternative 4 and replaces certain site-specific bank protection measures that resulted in substantial environmental deficits as calculated by the Corps' Standard Assessment Methodology (SAM) or estimated losses of riparian vegetation. Environmental neutrality is defined as full replacement or greater of riparian vegetation losses. While mitigation outside of SRBPP sites is not anticipated under this alternative, it is considered acceptable if ultimately needed and would be provided within the region of impact (e.g., 1a, 1b, 2, or 3). Table ES-1 identifies the specific bank protection measures assigned to each site.

Sub-Alternative 5B–Habitat Replacement Reaching Environmental Neutrality within Economically Justified Basins

Sub-Alternative 5B applies a combination of site-specific bank protection measures to 18 sites within the seven economically justified basins. Table ES-1 identifies the specific bank protection measures assigned to each site.

Alternative 6A–Habitat Replacement with ETL Variance

Alternative 6A applies the bank protection measures from the Final Alternatives Report without modification (Bank Protection Measures 1, 4a, 4b, 4c, and 5). While setback levees are included in the Final Alternatives Report, they were applied to very few sites as a result of the design selection process because the process required identification of a willing seller prior to a site being considered for a setback levee. A number of the bank protection measures utilized include protection of existing vegetation and placement of on-site mitigation vegetation within the VFZ and would require a Vegetation ETL variance. The area where vegetation would be preserved under a variance is typically that which is on the lower two-thirds of the waterside levee slope and the area within 15 feet of the waterside levee toe. The portion of vegetation within this area that does not need to be removed for construction purposes would be retained. Additionally, this area could be planted as a part of project construction if there are portions without vegetation. Off-site mitigation may be acceptable on a site-specific basis provided that the mitigation compensates for the values being lost and would be provided within the region of impact (e.g., 1a, 1b, 2, or 3). Table ES-1 identifies the specific bank protection measures assigned to each site.

Sub-Alternative 6B–Habitat Replacement with ETL Variance within Economically Justified Basins

Sub-Alternative 6B applies the bank protection measures from the Final Alternatives Report without modification to 18 sites within the seven economically justified basins. A number of these bank protection measures include protection of existing vegetation and placement of on-site mitigation vegetation within the VFZ and would require a Vegetation ETL variance. Off-site mitigation is acceptable and would be provided within the region of impact (e.g., 1a, 1b, 2, or 3). Table ES-1 identifies the specific bank protection measures assigned to each site.

Preferred Alternative

The Corps and CVFPB have identified Alternative 4A (and Sub-Alternative 4B) as the preferred alternative. The selection was made based on Alternative 4's ability to meet the project purpose and objectives, engineering and economic feasibility, and mitigation of environmental effects. Under this alternative, up to 80,000 LF of erosion protection would be constructed within economically justified basins. Based on the latest economic analysis, there are 7 economically justified basins currently identified, and these are represented as Alternative 4B for the purpose of this analysis. The project would be implemented as Alternative 4B, but the basins that are included in this alternative may change as subsequent economic analysis is conducted. The Corps will continue to update the economic analysis approximately every 5 years and/or as erosion sites are identified in areas not evaluated. In addition, there may be some refinement of the determination of basins as units for this analysis through further engineering and economic assessment. Erosion sites identified outside economically justified basins would be referred to the nonfederal sponsor for construction through a Section 408 action (33 United States Code Section 408), which would be triggered by the alteration of a federal project levee.

Environmentally Preferable Alternative/Environmentally Superior Alternative

Alternative 3A is the environmentally superior alternative under CEQA and the environmentally preferable alternative under NEPA. While there are many similarities among the environmental effects associated with Alternatives 3A through 6A, Alternative 3A is superior because it minimizes construction-related effects associated with water quality, vegetation, fish, and wildlife. In addition, Alternative 3A is the most consistent with natural resource agency input received during the public scoping process. Although the No Action Alternative would cause fewer direct environmental effects than Alternative 3A, it would not meet the proposed program's purpose and need or objectives.

It should be noted that Alternative 3A is expected to have somewhat greater effects with regard to traffic and air quality. Additionally, Alternative 3A does not provide the most improvements to fish habitat as determined by the SAM when compared with Alternatives 4A through 6A. However, Alternative 3A would cause the least disruption to existing fish and riparian habitat and would provide substantial opportunities for floodplain restoration. Effects on land use and higher costs associated with land purchase and construction are considered substantial challenges to Alternative 3A.

Conclusions of the Environmental Analysis

NEPA and CEQA are similar in that both laws require the preparation of an environmental study to evaluate the environmental effects of proposed lead agency activities. However, there are several differences between the two laws regarding terminology, procedures, environmental document content, and substantive mandates to protect the environment. For this environmental evaluation, the more rigorous of the two laws was applied in cases in which NEPA and CEQA differ. This is described further in Chapter 3, Guide to Effects Analysis.

Effects and Mitigation Measures

The proposed alternatives could result in significant or beneficial effects on various resources, depending on which alternative is implemented at individual repair sites.

Table ES-2 summarizes the findings of effects before mitigation and the proposed mitigation measures to avoid or reduce significant effects, and also indicates whether implementation of recommended mitigation measures would reduce the level of effect to less than significant. The findings in Table ES-2 are presented by resource topic. Table ES-3 provides an opportunity to compare the effects (after mitigation) of Alternatives 2A, 3A, 4A, 5A, and 6A, as well as Sub-Alternatives 2B through 6B.

Alternative 1–No Action Alternative

The No Action Alternative would not result in any construction activities associated with the proposed program (i.e., activities that would result in adverse effects on environmental resources). As detailed above, the Corps would not implement bank protection along SRFCP levees under the No Action Alternative. It is possible that federal, state, or local flood control agencies would eventually implement bank protection at various sites along SRFCP levees through emergency action.

Table ES-2. Summary of Effects and Mitigation Measures

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	FCGEOM-MM-1: Conduct Site-Specific Studies at Levee Repair Sites and Minimize Changes in Local Hydraulic Conditions through Project Design	Less than significant
Effect FCGEOM-2: Increase in Levee Slope Stability			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Beneficial	None required	—
Effect FCGEOM-3: Decrease in Instream Woody Material Recruitment			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	FISH-MM-2: Compensate for Loss of Fish Habitat VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Less than significant
Effect FCGEOM-4: Changes in Local Hydraulics and Shear Stress			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	FCGEOM-MM-1: Conduct Site-Specific Studies at Levee Repair Sites and Minimize Changes in Local Hydraulic Conditions through Project Design	Less than significant
Effect FCGEOM-5: Minimization of Stream Energy and Associated Floodplain Scour and/or Deposition			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—
Alternative 3A through Sub-Alternative 6B	Beneficial	None required	—
FCGEOM-6: Substantially Alter the Existing Drainage Pattern of the Site or Area			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—
Alternative 3A through Sub-Alternative 6B	Significant	FCGEOM-MM-2: Coordinate with Owners and Operators, Prepare Drainage Studies as Needed, and Remediate Effects through Project Design	Less than significant
Effect WQ-1: Temporary Increase in Turbidity and Suspended Solids during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	WQ-MM-1: Monitor Turbidity during Construction	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than Significant	WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality	Less than significant
Effect GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture			
Alternative 1 through Sub-Alternative 6B	No effect	None required	—
Effect GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect TN-1: Temporary Increase in Traffic Volumes from Construction-Generated Traffic and Potential Degradation of LOS for Roadways in the Vicinity of the Program			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Less than significant
Effect TN-2: Potential Increase in Safety Hazards Attributable to Construction-Generated Traffic			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Less than significant
Effect TN-3: Increase Emergency Response Times			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Less than significant
Effect TN-4: Potential Inadequate Parking Supply to Meet Parking Demand for Construction Equipment and Construction Workers			
Alternative 1 through Sub-Alternative 6B	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect TN-5: Potential Conflict with Alternative Transportation Modes because of Temporary Road Closures			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Less than significant
Effect TN-6: Temporary Changes to Navigation			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect TN-7: Potential Rerouting of Roads			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—
Alternative 3A through Sub-Alternative 6B	Significant	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Less than significant
Effect AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	AQ-MM-1a: Apply Applicable Air District's Mitigation Measures to Reduce Construction Emissions below *de minimis* Threshold Levels AQ-MM-1b: Offset Construction-Generated NO_X Emissions to Net Zero (0) for NO_X Emissions in Excess of *de minimis* Thresholds	Significant and unavoidable
Effect AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	AQ-MM-2: Apply Applicable Air District's Mitigation Measures to Reduce Operational Emissions below Federal *de minimis* Thresholds	Less than significant
Effect AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	AQ-MM-3: Apply Applicable Air District's Mitigation Measures to Reduce Construction Emissions below Applicable Air District's Thresholds	Significant and unavoidable
Effect AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related HAPs/TACs			
Alternative 1—No Action	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 2A through Sub-Alternative 6B	Significant	AQ-MM-4: Apply Applicable Air District's Mitigation Measures to Reduce HAP/TAC Emissions below the Applicable Air District's HAP/TAC Thresholds	Less than significant
Effect AQ-5: Generation of Operational Emissions in Excess of Applicable Standards			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	AQ-MM-5: Apply Applicable Air District's Mitigation Measures to Reduce Operational Emissions below Applicable Air District's Thresholds	Less than significant
Effect AQ-6: Generation of Construction GHG Emissions that May Have a Significant Impact on the Environment			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	AQ-MM-6: Implement Measures to Minimize GHG Emissions from Construction Activities	Significant and unavoidable
Effect AQ-7: Generation of Operational GHG Emissions that May Have a Significant Impact on the Environment			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	AQ-MM-6: Implement Measures to Minimize GHG Emissions from Construction Activities	Significant and unavoidable
Effect NOI-1: Exposure of Sensitive Receptors Adjacent to the Levee Construction Sites to Temporary Construction-Related Noise			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	NOI-MM-1: Employ Noise-Reducing Construction Practices to Comply with Applicable Noise Impact Criteria	Significant and unavoidable
Effect NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	NOI-MM-2: Conduct Vibration Monitoring at Buildings within 40 feet of Construction Equipment	Significant and unavoidable
Effect NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities			
Alternative 1—No Action	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 2A through Sub-Alternative 6B	Significant	NOI-MM-1: Employ Noise-Reducing Construction Practices to Comply with Applicable Noise Impact Criteria NOI-MM-3: Employ Emergency Repair Practices to Reduce Noise Where Feasible	Significant and unavoidable
Effect VEG-1: Permanent Loss of Woody Riparian Vegetation Resulting from Compliance with the Vegetation ETL			
Alternative 1—No Action	No effect	None required	—
Alternative 2A and Sub-Alternative 2B	Significant	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat VEG-MM-2: Retain Qualified Botanists to Conduct Floristic Surveys for Special-Status Plants during Appropriate Identification Periods VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel	Significant and unavoidable
Alternative 3A through Sub-Alternative 5B	Significant	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat VEG-MM-2: Retain Qualified Botanists to Conduct Floristic Surveys for Special-Status Plants during Appropriate Identification Periods VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel	Less than significant
Alternative 6A and Sub-Alternative 6B	No effect	None required	—
Effect VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 2A through Sub-Alternative 6B	Significant	VEG-MM-2: Retain Qualified Botanists to Conduct Floristic Surveys for Special-Status Plants during Appropriate Identification Periods VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel VEG-MM-5: Install Construction Barrier Fencing to Protect Sensitive Biological Resources Adjacent to the Construction Zone VEG-MM-6: Retain a Biological Monitor	Significant and unavoidable
Effect VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A and Sub-Alternative 2B	Significant	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat VEG-MM-2: Retain Qualified Botanists to Conduct Floristic Surveys for Special-Status Plants during Appropriate Identification Periods VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 3A through Sub-Alternative 6B	Significant	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat VEG-MM-2: Retain Qualified Botanists to Conduct Floristic Surveys for Special-Status Plants during Appropriate Identification Periods VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel	Less than significant
Effect VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel VEG-MM-5: Install Construction Barrier Fencing to Protect Sensitive Biological Resources Adjacent to the Construction Zone VEG-MM-6: Retain a Biological Monitor VEG-MM-7: Redesign Proposed Projects to Avoid and Minimize Effects on Sensitive Biological Resources VEG-MM-8: Compensate for the Loss of Wetlands and Other Waters	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel VEG-MM-5: Install Construction Barrier Fencing to Protect Sensitive Biological Resources Adjacent to the Construction Zone VEG-MM-6: Retain a Biological Monitor VEG-MM-7: Redesign Proposed Projects to Avoid and Minimize Effects on Sensitive Biological Resources VEG-MM-8: Compensate for the Loss of Wetlands and Other Waters VEG-MM-9: Conduct a Tree Survey VEG-MM-10: Compensate for the Loss of Protected Trees	Less than significant
Effect VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	VEG-MM-11: Conduct a Survey to Document Invasive Plant Infestations VEG-MM-12: Avoid and Minimize the Spread or Introduction of Invasive Plant Species VEG-MM-13: Conduct a Follow-Up Weed Survey and Implement Eradication Methods if New Infestations Are Present	Less than significant
Effect VEG-7: Potential Opportunity for Habitat Restoration in Enlarged Floodplain following Program Construction			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—
Alternative 3A through Sub-Alternative 6B	Beneficial	None required	—
Effect FISH-1: Short-Term Effects of Rock Placement into Nearshore Aquatic Habitat during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A, Sub-Alternative 2B, and Alternative 4A through Sub-Alternative 6B	Significant	FISH-MM-1: Limit Construction Activity to Periods of the Year That Minimize Effects on Fish	Less than significant
Alternative 3A and Sub-Alternative 3B	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	WQ-MM-1: Monitor Turbidity during Construction FISH-MM-1: Limit Construction Activity to Periods of the Year That Minimize Effects on Fish	Less than significant
Effect FISH-3: Spillage and Leakage of Contaminants during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	FISH-MM-1: Limit Construction Activity to Periods of the Year That Minimize Effects on Fish WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality	Less than significant
Effect FISH-4: Long-Term Effects on Fish from Loss of Habitat			
Alternative 1—No Action	No effect	None required	—
Alternative 2A and Sub-Alternative 2B	Significant	FISH-MM-2: Compensate for Loss of Fish Habitat FISH-MM-3: Compensate for the Loss of Spawning Habitat	Significant and unavoidable
Alternative 3A and Sub-Alternative 3B	Significant	FISH-MM-2: Compensate for Loss of Fish Habitat VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Less than significant
Alternative 4A through Sub-Alternative 6B	Significant	FISH-MM-2: Compensate for Loss of Fish Habitat FISH-MM-3: Compensate for Loss of Spawning Habitat VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Less than significant
Effect WILD-1: Permanent Loss of Riparian Habitat for Special-Status Wildlife Species Associated with Compliance with the Vegetation ETL			
Alternative 1—No Action	No effect	None required	—
Alternative 2A, Sub-Alternative 2B, and Alternative 4A through Sub-Alternative 5B	Significant	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Significant and unavoidable
Alternative 3A and Sub-Alternative 3B	Significant	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Less than significant
Alternative 6A and Sub-Alternative 6B	No effect	None required	—
Effect WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities			
Alternative 1—No Action	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 2A, Sub-Alternative 2B, and Alternative 4A through Sub-Alternative 6B	Significant	WILD-MM-1: Document Special-Status Wildlife Species and Their Habitats WILD-MM-2: Avoid and Minimize Effects on Special-Status Wildlife Species by Redesigning the Action, Protecting Special-Status Wildlife Habitat, and Developing a Mitigation Monitoring Plan (If Necessary) WILD-MM-3: Coordinate with Resource Agencies and Develop Appropriate Wildlife Compensation Plans for Species Listed under ESA and/or CESA VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel VEG-MM-8: Compensate for the Loss of Wetlands and Other Waters	Significant and unavoidable
Alternative 3A and Sub-Alternative 3B	Significant	WILD-MM-1: Document Special-Status Wildlife Species and Their Habitats WILD-MM-2: Avoid and Minimize Effects on Special-Status Wildlife Species by Redesigning the Action, Protecting Special-Status Wildlife Habitat, and Developing a Mitigation Monitoring Plan (If Necessary) WILD-MM-3: Coordinate with Resource Agencies and Develop Appropriate Wildlife Compensation Plans for Species Listed under ESA and/or CESA VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel VEG-MM-8: Compensate for the Loss of Wetlands and Other Waters	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	WILD-MM-4: Avoid or Minimize Construction-Related Effects on Nesting Birds WILD-MM-5: Conduct a Preconstruction Survey for Roosting Bats and Avoid or Mitigate Potential Impacts	Less than significant
Effect WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect LA-2: Conflicts with Local Land Use and Agriculture Policies			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect LA-3: Conversion of Important Farmland to Nonagricultural Uses			
Alternative 1—No Action	No effect	None required	—
Alternative 2A and Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A through Sub-Alternative 6B	Significant	LA-MM-1: Evaluate the Potential for Direct Farmland Conversion at the Project Level and Avoid, Minimize, and Compensate for Loss of Farmland	Significant and unavoidable
Effect REC-1: Temporary Disruption of Recreational Opportunities during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	REC-MM-1: Notify Recreation Users of Potential Construction Hazards REC-MM-2: Provide Alternate Recreation Routes	Less than significant
Effect REC-2: Long-Term Reduction in Quality of Existing Recreational Opportunities within the Levee Corridor			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Significant and unavoidable
Effect REC-3: Temporary Obstruction of Access to Marina or Boat Launch Facilities			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 3A through Sub-Alternative 6B	Significant	REC-MM-3: Preserve Marina and Boat Launch Access	Less than significant
Effect REC-4: Permanent Loss of Recreational Opportunities			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—
Alternative 3A through Sub-Alternative 6B	Significant	REC-MM-4: Rebuild Affected Formal Park Facilities and Trails	Less than significant
Effect REC-5: Safety Hazards to Recreationists			
Alternative 1 through Sub-Alternative 3B	No effect	None required	—
Alternative 4A through Sub-Alternative 6B	Significant	REC-MM-5: Hazard-Reducing Placement of Instream Woody Mat	Less than significant
Effect POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect PUB-1: Potential for Damage of Utility Infrastructure and Disruption of Service during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	PUB-MM-1: Verify Utility Locations, Coordinate with Utility Providers, Prepare and Implement a Response Plan, and Conduct Worker Training	Less than significant
Effect PUB-2: Potential Disruption to Irrigation Water Supply			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—
Alternative 3A through Sub-Alternative 6B	Significant	PUB-MM-2: Coordinate with Irrigation Water Users Before and During Infrastructure Modifications and Minimize Disruptions to Supply	Less than significant
Effect VIS-1: Temporary Visual Effects Caused by Construction Activities			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	VIS-MM-1: Install Temporary Visual Barriers between Construction Zones and Residences and Maintain Construction Sites and Staging Areas in an Orderly Fashion	Significant and unavoidable
Effect VIS-2: Substantially Adversely Affect a Scenic Vista			
Alternative 1—No Action	No effect	None required	—
Alternative 2A and Sub-Alternative 2B	Less than significant	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 3A through Sub-Alternative 5B	Significant	Mitigation not available	Significant and unavoidable
Alternative 6A and Sub-Alternative 6B	Less than significant	None required	—
Effect VIS-3: Substantially Damage Scenic Resources, including, but Not Limited to, Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	Mitigation not available	Significant and unavoidable
Effect VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	Mitigation not available	Significant and unavoidable
Effect VIS-5: Create a New Source of Light or Glare			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	Mitigation not available	Significant and unavoidable
Effect PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality PH-MM-1: Employ a Toxic Release Contingency Plan	Less than significant
Effect PH-3: Temporary Exposure to Safety Hazards from the Construction Site			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	PH-MM-2: Implement Construction Site Safety Measures PH-MM-3: Implement an Emergency Response Plan	Less than significant
Effect PH-4: Exposure of People or Structure to Increased Flood Risk			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Beneficial	None required	—
Effect PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 3A, Sub-Alternative 3B, Alternative 5A, and Sub-Alternative 5B	Significant	PH-MM-4: Design and Manage Habitat Created by Setback Levees Such That It Does Not Attract Wildlife Known to Collide with Aircraft	Less than significant
Effect CUL-1: Disturbance of Native American or Historic Period Human Remains			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	CUL-MM-1: Stop Work if Human Remains Are Discovered	Significant and unavoidable
Effect CUL-2: Unavoidable Impacts on Historic Properties or Historical Resources as a Result of Bank Protection Measures			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Significant	CUL-MM-2: Identify Historic Properties and Historical Resources and Implement Treatment Measures for Adverse Effects according to the Historic Properties Treatment Plan	Less than significant
Effect CUL-3: Loss of Integrity of Character-Defining Elements that Would Qualify the Sacramento River Levee System as a Historic Property or Historical Resource			
Alternative 1 through Sub-Alternative 2B	No effect	None required	—
Alternative 3A through Sub-Alternative 6B	Significant	CUL-MM-3: Evaluate the Sacramento River Levee System for NRHP Eligibility and Implement Treatment Measures for Adverse Effects According to the Historic Properties Treatment Plan	Less than significant
Effect SOC-1: Disproportionate Effect on Minority or Low-Income Populations			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Less than significant	None required	—
Effect SOC-2: Temporary Increase in Employment during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A through Sub-Alternative 6B	Beneficial	None required	—

Note: In the Alternative column, *through* is inclusive. For example, *Alternative 2A through Sub-Alternative 6B* consists of Alternative 2A, Sub-Alternative 2B, Alternative 3A, Sub-Alternative 3B, Alternative 4A, Sub-Alternative 4B, Alternative 5A, Sub-Alternative 5B, Alternative 6A and Sub-Alternative 6B. The findings and mitigation measures, if any, are the same for each alternative and sub-alternative.

Table ES-3. Summary Comparison of Alternatives with Mitigation Considered

Effect[1]	Alternative 2A—Low Maintenance	Alternative 3A—Maximize Meander Zone	Alternative 4A—Habitat Replacement	Alternative 5A—Habitat Replacement Reaching Environmental Neutrality	Alternative 6A—Habitat Replacement with Vegetation ETL Variance
Flood Control and Geomorphology					
FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
FCGEOM-2: Increase in Levee Slope Stability	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial
FCGEOM-3: Decrease in Instream Woody Material Recruitment	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
FCGEOM-4: Changes in Local Hydraulics and Shear Stress	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
FCGEOM-5: Minimization of Stream Energy and Associated Floodplain Scour and/or Deposition	No effect	Beneficial	Beneficial	Beneficial	Beneficial
FCGEOM-6: Substantially Alter the Existing Drainage Pattern of the Site or Area	No effect	Less than significant*	Less than significant*	Less than significant*	Less than significant*
Water Quality and Groundwater Resources					
WQ-1: Temporary Increase in Turbidity and Suspended Solids during Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
Geology, Seismicity, Soils, and Mineral Resources					
GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture	No effect	No effect	No effect	No effect	No effect
GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant

Effect[1]	Alternative 2A—Low Maintenance	Alternative 3A—Maximize Meander Zone	Alternative 4A—Habitat Replacement	Alternative 5A—Habitat Replacement Reaching Environmental Neutrality	Alternative 6A—Habitat Replacement with Vegetation ETL Variance
GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
Transportation and Navigation					
TN-1: Temporary Increase in Traffic Volumes from Construction-Generated Traffic and Potential Degradation of LOS for Roadways in the Vicinity of the Program	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
TN-2: Potential Increase in Safety Hazards Attributable to Construction-Generated Traffic	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
TN-3: Increase Emergency Response Times	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
TN-4: Potential Inadequate Parking Supply to Meet Parking Demand for Construction Equipment and Construction Workers	No effect	No effect	No effect	No effect	No effect
TN-5: Potential Conflict with Alternative Transportation Modes because of Temporary Road Closures	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
TN-6: Temporary Changes to Navigation	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
TN-7: Potential Rerouting of Roads	No effect	Less than significant*	Less than significant*	Less than significant*	Less than significant*
Air Quality and Climate Change					
AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*

Effect[1]	Alternative 2A—Low Maintenance	Alternative 3A—Maximize Meander Zone	Alternative 4A—Habitat Replacement	Alternative 5A—Habitat Replacement Reaching Environmental Neutrality	Alternative 6A—Habitat Replacement with Vegetation ETL Variance
AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related HAPs/TACs	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
AQ-5: Generation of Operational Emissions in Excess of Applicable Standards	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
AQ-6: Generation of Construction GHG Emissions that May Have a Significant Effect on the Environment	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
AQ-7: Generation of Operational GHG Emissions that May Have a Significant Effect on the Environment	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
Noise and Vibration					
NOI-1: Exposure of Sensitive Receptors Adjacent to the Levee Construction Sites to Temporary Construction-Related Noise	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
Vegetation and Wetlands					
VEG-1: Permanent Loss of Woody Riparian Vegetation Resulting from Compliance with the Vegetation ETL	Significant and unavoidable*	Less than significant*	Less than significant*	Less than significant*	No effect
VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*

Effect[1]	Alternative 2A—Low Maintenance	Alternative 3A—Maximize Meander Zone	Alternative 4A—Habitat Replacement	Alternative 5A—Habitat Replacement Reaching Environmental Neutrality	Alternative 6A—Habitat Replacement with Vegetation ETL Variance
VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction	Significant and unavoidable*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
VEG-7: Potential Opportunity for Habitat Restoration in Enlarged Floodplain following Program Construction	No effect	Beneficial	Beneficial	Beneficial	Beneficial
Fisheries and Aquatics					
Short-Term Effects					
FISH-1: Short-Term Effects of Rock Placement into Nearshore Aquatic Habitat during Construction	Less than significant*	No effect	Less than significant*	Less than significant*	Less than significant*
FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
FISH-3: Spillage and Leakage of Contaminants during Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
Long-Term Effects					
FISH-4: Long-Term Effects on Fish from Loss of Habitat	Significant and unavoidable*	Less than significant*	Less than significant*	Less than significant*	Less than significant*

Effect[1]	Alternative 2A—Low Maintenance	Alternative 3A—Maximize Meander Zone	Alternative 4A—Habitat Replacement	Alternative 5A—Habitat Replacement Reaching Environmental Neutrality	Alternative 6A—Habitat Replacement with Vegetation ETL Variance
Wildlife					
WILD-1: Permanent Loss of Riparian Habitat for Special-Status Wildlife Species Associated with Compliance with the Vegetation ETL	Significant and unavoidable*	Less than significant*	Significant and unavoidable*	Significant and unavoidable*	No effect
WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities	Significant and unavoidable*	Less than significant*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
Land Use and Agriculture					
LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
LA-2: Conflicts with Local Land Use and Agriculture Policies	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
LA-3: Conversion of Important Farmland to Nonagricultural Uses	Less than significant	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
Recreation					
REC-1: Temporary Disruption of Recreational Opportunities during Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
REC-2: Long-Term Reduction in Quality of Existing Recreational Opportunities within the Levee Corridor	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
REC-3: Temporary Obstruction of Access to Marina or Boat Launch Facilities	No effect	Less than significant*	Less than significant*	Less than significant*	Less than significant*

Effect[1]	Alternative 2A—Low Maintenance	Alternative 3A—Maximize Meander Zone	Alternative 4A—Habitat Replacement	Alternative 5A—Habitat Replacement Reaching Environmental Neutrality	Alternative 6A—Habitat Replacement with Vegetation ETL Variance
REC-4: Permanent Loss of Recreational Opportunities	No effect	Less than significant*	Less than significant*	Less than significant*	Less than significant*
REC-5: Safety Hazards to Recreationists	No effect	No effect	Less than significant*	Less than significant*	Less than significant*
Population and Housing					
POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
Utilities and Public Services					
PUB-1: Potential for Damage of Utility Infrastructure and Disruption of Service during Construction	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
PUB-2: Potential Disruption to Irrigation Water Supply	No effect	Less than significant*	Less than significant*	Less than significant*	Less than significant*
Aesthetics					
VIS-1: Temporary Visual Effects Caused by Construction Activities	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
VIS-2: Substantially Adversely Affect a Scenic Vista	Less than significant	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable	Less than significant
VIS-3: Substantially Damage Scenic Resources, including, but Not Limited to Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable
VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable
VIS-5: Create a New Source of Light or Glare	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable

Effect[1]	Alternative 2A—Low Maintenance	Alternative 3A—Maximize Meander Zone	Alternative 4A—Habitat Replacement	Alternative 5A—Habitat Replacement Reaching Environmental Neutrality	Alternative 6A—Habitat Replacement with Vegetation ETL Variance
Public Health and Environmental Hazards					
PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
PH-3: Temporary Exposure to Safety Hazards from the Construction Site	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
PH-4: Exposure of People or Structure to Increased Flood Risk	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial
PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife	No effect	Less than significant*	Less than significant	Less than significant*	Less than significant
Cultural Resources					
CUL-1: Disturbance of Native American or Historic Period Human Remains	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*	Significant and unavoidable*
CUL-2: Unavoidable Impacts on Historic Properties or Historical Resources as a Result of Bank Protection Measures	Less than significant*	Less than significant*	Less than significant*	Less than significant*	Less than significant*
CUL-3: Loss of Integrity of Character-Defining Elements That Would Qualify the Sacramento River Levee System as a Historic Property or Historical Resource	No effect	Less than significant*	Less than significant*	Less than significant*	Less than significant*
Socioeconomics and Environmental Justice					
SOC-1: Disproportionate Effect on Minority or Low-Income Populations	Less than significant	Less than significant	Less than significant	Less than significant	Less than significant
SOC-2: Temporary Increase in Employment during Construction	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial

Effect[1]	Alternative 2A—Low Maintenance	Alternative 3A—Maximize Meander Zone	Alternative 4A—Habitat Replacement	Alternative 5A—Habitat Replacement Reaching Environmental Neutrality	Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Explanations:

[1] Alternative 1—No Action Alternative would not result in any significant effects associated with implementation of the proposed program; therefore, there would be no effects.

* (Asterisk)—denotes those effects that were found to be less than significant, with the implementation of recommended mitigation measure, and those effects that that were found to be significant and unavoidable despite the implementation of recommended mitigation measures.

Sub-Alternatives to Alternatives 2A through 6A (within Economically Justified Basins) were not reflected in this effect summary table because the effect conclusions were found to be the same as the associated alternative in all cases. For a discussion of effects associated with the sub-alternatives, please see Chapter 21.

Continued erosion prior to the federal, state or local action would result in short- and long-term losses of valuable habitat. Although some erosion is natural, the channelization of project reaches increases erosive forces. These potential scenarios would result in adverse effects on the environment. However, these effects are not a result of the proposed program and would have no effect (or *no impact* in CEQA terms) associated with implementation of any of the program alternatives. Therefore, Table ES-2 characterizes the findings of effects under Alternative 1–No Action Alternative as "No effect."

Effects Found to be Less than Significant

The EIS/EIR found that the proposed program, when mitigation is considered, would have less-than-significant effects on these resources.

- Flood control and geomorphology
- Water quality and groundwater
- Geology, soils, seismicity and minerals
- Transportation and navigation
- Air quality and climate change
- Noise
- Vegetation and wetlands
- Fisheries and aquatics
- Wildlife
- Land use and agriculture
- Recreation
- Population and housing
- Utilities and public services
- Aesthetics
- Public health and environmental hazards
- Cultural resources
- Socioeconomics and environmental justice

Significant and Unavoidable Effects

The proposed program would result in significant and unavoidable effects on the resources listed here.

- Air quality and climate change
- Noise
- Vegetation and wetlands
- Fisheries and aquatics

- Wildlife
- Land use and agriculture
- Recreation
- Aesthetics
- Cultural resources

Beneficial Effects of the Proposed Program

The EIS/EIR concluded that the proposed program would have beneficial effects on the resources listed here.

- Flood control and geomorphology
- Vegetation and wetlands
- Public health and environmental hazards
- Socioeconomics and environmental justice

Areas of Known Controversy and Unresolved Issues

CEQA Guidelines (14 California Code of Regulations [CCR] Section 15123(b)) requires that an EIR summary describe areas of controversy known to the lead agency, including issues raised by agencies and the public as well as unresolved issues. NEPA regulations also require disclosure of areas of controversy and issues to be resolved (40 Code of Federal Regulations [CFR] Section 1502.12).

The following issue areas were identified during the NOI/NOP scoping period.

- Vegetation on levees.
- Economic impacts on rural communities.
- Hydraulic effects.
- Public outreach and agency coordination.
- Invasive species.
- Construction impacts, including routes for transporting materials.
- Effects on fish, wildlife, and vegetation, including Central Valley salmonids and bank swallow habitat.
- Erosion site locations and selection.
- Mitigation of impacts.
- Consideration of setback levees.
- Cumulative effects.
- Eminent domain as a possible tool for real estate acquisition.

Irreversible and Irretrievable Commitments of Resources/Significant Irreversible Environmental Changes

State CEQA Guidelines (14 CCR 15126.2(c)) and NEPA (40 CFR Section 1502.16) require analysis of significant irreversible and irretrievable effects. CEQA requires evaluation of irretrievable resources to ensure that their use is justified. NEPA requires an explanation of which environmental impacts are irreversible or would result in an irretrievable commitment of resources.

Irreversible impacts are those that cause, through direct or indirect effects, use or consumption of resources in such a way that they cannot be restored or returned to their original condition despite mitigation. Potentially irreversible impacts are documented in this EIS/EIR. An irretrievable impact or commitment of resources occurs when a resource is removed or consumed. These types of impacts are evaluated to ensure that consumption is justified.

All the program alternatives would involve a commitment of a range of natural, physical, and fiscal resources as follows.

- Construction materials.
- Nonrenewable resources, such as gasoline and diesel oil used to power equipment and vehicles used for construction, and for operations and routine maintenance.
- Additional electrical power from a renewable resource (i.e., for lighting and operations).
- Land conversion of open space, agricultural, and natural environments.

Any construction would require expenditure of state and federal funds for the costs of construction and right-of-way. The proposed program would also require funding for operation and maintenance of the constructed sites and for vegetation establishment and monitoring associated with mitigation.

The decision by the Lead Agencies to commit these resources is based on the concept that residents in the immediate area, region, and state would benefit from the implementation of the proposed program. The overarching benefit of the proposed program is that the integrity of the flood control system would be maintained through the application of site-specific bank protection measures to remedy erosion sites with high failure potential in order prevent levee failure, catastrophic damage, and possible loss of life. Implementation of the SRBPP and 80,000 LF of additional bank protection would ensure the continued integrity of the SRFCP levees while protecting environmental resources and compensating for effects on significant environmental resources to the degree feasible. These benefits are expected to outweigh the commitment of these resources.

Relationship between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

The Council on Environmental Quality NEPA Regulations (40 CFR Part 1500 et seq.) require that an EIS discuss issues related to environmental sustainability. In general, this EIS discussion is not considered an environmental effect for which significance is defined or mitigation is recommended.

However, the discussion, as it relates to environmental consequences, should consider "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (42 United States Code 4332 Section (C)(iv)).

The short-term effects on and uses of the environment in the vicinity of the program area are related to long-term effects and the maintenance and enhancement of long-term productivity. "Short term" refers to the total duration of construction: the multi-year construction period to construct 80,000 LF of bank protection and associated mitigation elements. Construction associated with the proposed program would cause short-term impacts on the environment related to alteration of topography and hydrologic conditions, water quality, biological resources, air quality, land use, recreation, visual resources, and the human environment (noise and traffic conditions).

"Long term" refers to an indefinite period beyond the initial construction at the erosion sites and includes ongoing operation and maintenance of the sites as well as vegetation establishment and monitoring activities. Vegetation establishment and monitoring would be necessary to ensure that the mitigation vegetation is functioning as intended.

Implementation of the proposed program includes bank repair and levee rehabilitation would result in long-term benefits, including protection of property and the health and safety of residents. The proposed river bank repair and mitigation work would greatly minimize erosion, limiting the eventual loss of nearshore aquatic habitat and riparian habitat that would likely occur if the proposed program were not enacted.

Public Involvement and Agency Coordination

The Lead Agencies are implementing a comprehensive public participation program to fully inform and engage potentially affected agencies, stakeholders and communities.

Notice of Preparation/Notice of Intent Scoping

In January 2009, the Lead Agencies issued a Notice of Preparation (NOP) of an EIR and a Notice of Intent (NOI) to prepare an EIS, informing agencies and the general public that an EIS/EIR was being prepared and inviting comments on the scope and content of the document during the 45-day public review period. The NOI and NOP also requested participation at public scoping meetings. Appendix A includes the NOI as published in the Federal Register on January 30, 2009, and the NOP as distributed to responsible agencies and interested parties. In February 2009, the Lead Agencies hosted four public scoping meetings in Colusa, Walnut Grove, Sacramento, and Chico. Comment letters regarding the NOI and NOP and transcripts of the scoping meetings also are included in Appendix A.

To publicize the scoping meetings, advertisements were placed in the *Sacramento Bee*, the Colusa County *Sun Herald*, and the *Chico Enterprise-Record*. Meeting notices were also sent to 68 resource agencies, 22 local media contacts, 18 tribal contacts, eight levee districts, and 124 reclamation districts inviting them to the meeting or to provide input about the proposed program during the scoping period. Copies of the advertisements and meeting notice can be found in Appendix A.

Additionally, a letter was sent to elected officials inviting their attendance at the public scoping meetings and input on the proposed program. The letter was sent to the following members of the

House of Representatives: Wally Herger, Dan Lungren, Doris Matsui, Tom McClintock, Jerry McNerney, Ellen Tauscher, George Miller, and Mike Thompson.

Agency Consultation and Coordination

Consultations and coordination with numerous local, state, and federal agencies have been conducted throughout Phase II of the SRBPP. Chapter 24, Compliance with Applicable Laws, Policies, Plans, and Regulatory Framework, describes preliminary information on the major requirements for permitting and environmental review and consultation prior to implementation, including consultation to date with various agencies. The following is a summary of those coordination efforts.

Resource Agency Coordination

The Interagency Working Group (IWG) was formed as a term and condition of the draft (Jeopardy) and final biological opinions previously issued by USFWS and the National Marine Fisheries Service (NMFS) for Phase II. The IWG's primary purpose is to develop products for SRBPP planning, and to determine project impacts on listed species under the ESA and to coordinate related issues with state and federal natural resource agencies. Meetings are typically monthly and key participants represent the Corps, CVFPB, DWR, USFWS, NMFS, and DFW.

In addition, between September 16, 2008 and November 25, 2008, the Corps solicited input from agencies that have a direct interest in flood risk management and the environmental conditions associated with future locations and types of bank protection alternatives. Interviews were conducted with staff of NMFS, California State Lands Commission, DFW, USFWS, Corps, DWR and CVFPB to better understand their perspectives and vision for implementation of the additional 80,000 LF of bank protection. The interviews resulted in several recommendations for improvement of the SRBPP planning and implementation process, which are presented in Appendix A.

Native American Consultation

On May 4, 2009, the Native American Heritage Commission (NAHC) was contacted to request a search of the Sacred Lands File. The NAHC staff responded on May 12, 2009 with a list of Native American contacts for Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties. Native American groups with potential interest in the area were identified through the efforts of an ethnographer. A series of letters, phone calls, emails and two workshops open to Native American groups in the spring of 2010 were used to further identify interested parties. Correspondence included a map depicting the program area, a brief description of the proposed program, and a request for the contacts to share any knowledge or concerns they may have regarding cultural resources in or adjacent to the program area. Based on this work, the Corps has initiated consultation with the following tribes.

- Berry Creek Rancheria of Tyme Maidu Indians
- Buena Vista Rancheria of Me-Wuk Indians
- Cachil DeHe Band of Wintun Indians of the Colusa Indian Community
- California Valley Miwok Tribe
- Cortina Band of Indians, Enterprise Rancheria (Estom Yumeka)
- Grindstone Rancheria

- Ione Band of Miwok Indians
- Mechoopda Indian Tribe of Chico Rancheria
- Mooretown Rancheria of Maidu Indians
- Paskenta Band of Nomlaki Indians, Redding Rancheria
- Shingle Springs Band of Miwok Indians
- United Auburn Indian Community of Auburn Rancheria
- Wilton Rancheria
- Yocha Dehe Wintun Nation (Rumsey Rancheria)

The Corps and DWR determined that development of a Programmatic Agreement (PA) for the proposed program and an attending Historic Properties Treatment Plan (HPTP) would be the most effective way to comply with NEPA, Section 106 of the National Historic Preservation Act, and CEQA. The PA and HPTP can be found in Appendix C. Further consultation with the tribes included requesting comments on the PA and HPTP, additional outreach meetings with individual tribes, and requesting their participation as concurring parties to the PA. To date, the California Valley Miwok Tribe, Mechoopda Indian Tribe of Chico Rancheria, and the Shingle Springs Band of Miwok have signed as concurring parties. Those tribes that have not signed as concurring parties to the PA will still be given an opportunity to comment on specific construction projects as they are designed and planned.

Draft EIS/EIR Public Comments

This EIS/EIR will be circulated for a minimum of 45 days for public review to federal, state, and local agencies; organizations; and individuals who have an interest in the project. A notice of availability of the draft EIS/EIR will be published in the Federal Register and local newspapers when the document is released for public review. Public workshops will be held during the review period to provide additional opportunities for comments on the draft document. Public notices will be sent providing public workshop details. All comments received during the public review period will be considered and incorporated into the final EIS/EIR, as appropriate. A comment and response appendix will be included with the final document.

Copies of the draft EIS/EIR will be submitted to the State Clearinghouse in Sacramento for distribution to state agencies. Additionally, draft EIS/EIR will be available for public review on the SRBPP website (http://www.spk.usace.army.mil/Missions/CivilWorks/ SacramentoRiverBankProtection.aspx) and CVFPB website (http://www.cvfpb.ca.gov/PublicNotices/).

Chapter 1
Introduction

Introduction

The U.S. Army Corps of Engineers (Corps) and the Central Valley Flood Protection Board (CVFPB) (formerly The Reclamation Board) are preparing a joint programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Sacramento River Bank Protection Project (SRBPP) Phase II Supplemental Authority (proposed program) for implementation of up to 80,000 linear feet (LF) of additional bank protection in the Sacramento River Flood Control Project (SRFCP) area. The proposed program is authorized by Section 3031 of the Water Resources Development Act (WRDA) of 2007 (Public Law [Pub. L.] 110-114, Section 3031, 121 Statutes [Stat.] 1041, 1113 (2007)). The program area spans portions of Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties in California (Figure 1-1).

The SRBPP is a continuing long-term project authorized by Section 203 of the Flood Control Act of 1960 (Pub. L. 86-654, Section 203, 74 Stat. 498 (1960)). This project was authorized to provide protection to the existing levee and flood control facilities of the SRFCP. The SRFCP consists of more than approximately 1,000 miles of levees, plus overflow weirs, pumping plants, and bypass channels that protect communities and agricultural lands in the Sacramento Valley and Sacramento–San Joaquin River Delta (Delta).

Congress has authorized the SRBPP in two phases based on LF of bank protection. Phase I bank protection was completed in 1975 and resulted in 435,953 LF of bank protection. Current bank protection is being carried out under Phase II. The work authorized through Section 3031 of the WRDA 2007 (Pub. L. 110-114, Section 3031) for the SRBPP Phase II Supplemental Authority is a continuation of Phase II bank protection, and increases the amount of currently authorized bank protection (405,000 LF) by 80,000 LF to 485,000 LF. It is anticipated that this additional bank protection at erosion sites would be constructed over the next 10 years. Phase III (not evaluated as part of this proposed program) is future work that is needed to protect the SRFCP for which planning has been initiated by the Corps but which currently is not authorized. As construction of the Phase II Supplemental Authority is completed, implementation of Phase III will be critical to ensuring the SRFCP levees seriously threatened by erosion will receive corrective measures to prevent levee failure, catastrophic damage, and possible loss of life.

NEPA and CEQA Compliance

The National Environmental Policy Act (NEPA) of 1969 established a national environmental policy and goals for the protection, maintenance, and enhancement of the environment. It requires all federal agencies to incorporate environmental considerations into planning and decision-making. NEPA also established the President's Council on Environmental Quality (CEQ) and empowered CEQ to develop regulations by which all federal agencies would comply. These regulations are published in the Code of Federal Regulations (CFR) at 40 CFR Sections 1500–1508. The Corps has also promulgated its own Procedures for Implementing NEPA (33 CFR Part 230) to be used in conjunction with CEQ regulations.

For those actions with the potential to create significant environmental effects, the consideration of the proposed action and alternatives is presented in an environmental impact statement (EIS). Major federal agency actions typically fall within one of the following categories: (1) adoption of official policy (i.e., rulemaking); (2) adoption of formal plans; (3) adoption of programs (i.e., a group of concerted actions to implement a specific policy or plan); and (4) approval of specific projects (i.e., construction or management activities located in a specified geographic area) (40 CFR Section 1508.18(b)). In this case, the Corps is preparing this EIS because it is considering a program composed of a group of bank protection actions to implement the SRBPP Phase II Supplemental Authority.

The California Environmental Quality Act (CEQA) applies to all discretionary activities proposed to be carried out or approved by California public agencies, including state, regional, county, and local agencies and requires those agencies to prepare multidisciplinary environmental impact analyses of the activities. Enacted in 1970, CEQA was modeled on NEPA, but CEQA contains an explicit directive requiring agencies to avoid or reduce, when feasible, the significant environmental impacts of their decisions. If an action may cause significant effects on the environment, an agency must prepare an Environmental Impact Report (EIR) that analyzes the action's potential significant effects and identifies mitigation measures and reasonable alternatives to avoid the significant effects. CEQA is published in the Public Resources Code, Division 13, Sections 21000–21177.

There are several types of EIRs that may be prepared under CEQA. A Program EIR is prepared for an agency program or series of actions that can be characterized as one large project. Typically, such a project involves actions that are closely related either geographically or temporally. Program EIRs generally analyze broad environmental effects of the program with the acknowledgement that site-specific environmental review may be required for particular aspects of portions of the program when those aspects are proposed for implementation.

Document Overview and Purpose

This document is a joint programmatic EIS/EIR and satisfies the requirements of NEPA and CEQA for disclosing environmental impacts and recommended mitigation measures related to a proposed action and alternatives prior to a lead agency's decision on project approval. A joint EIS/EIR is prepared when a project is subject to both NEPA and CEQA. Both NEPA and CEQA provide guidelines for the preparation of a programmatic EIS/EIR.

A programmatic EIS/EIR is prepared for a series of actions that can be characterized as one large project and are related in any of the following ways:

- Geographically (i.e., same general location, region, or the same body of water) and could be characterized as one large project.
- As logical parts in the chain of contemplated actions.
- In connection with issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program.
- As individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects that can be mitigated in similar ways (i.e., common timing, impacts, alternatives, or methods of implementation) (State CEQA Guidelines Section 15168).

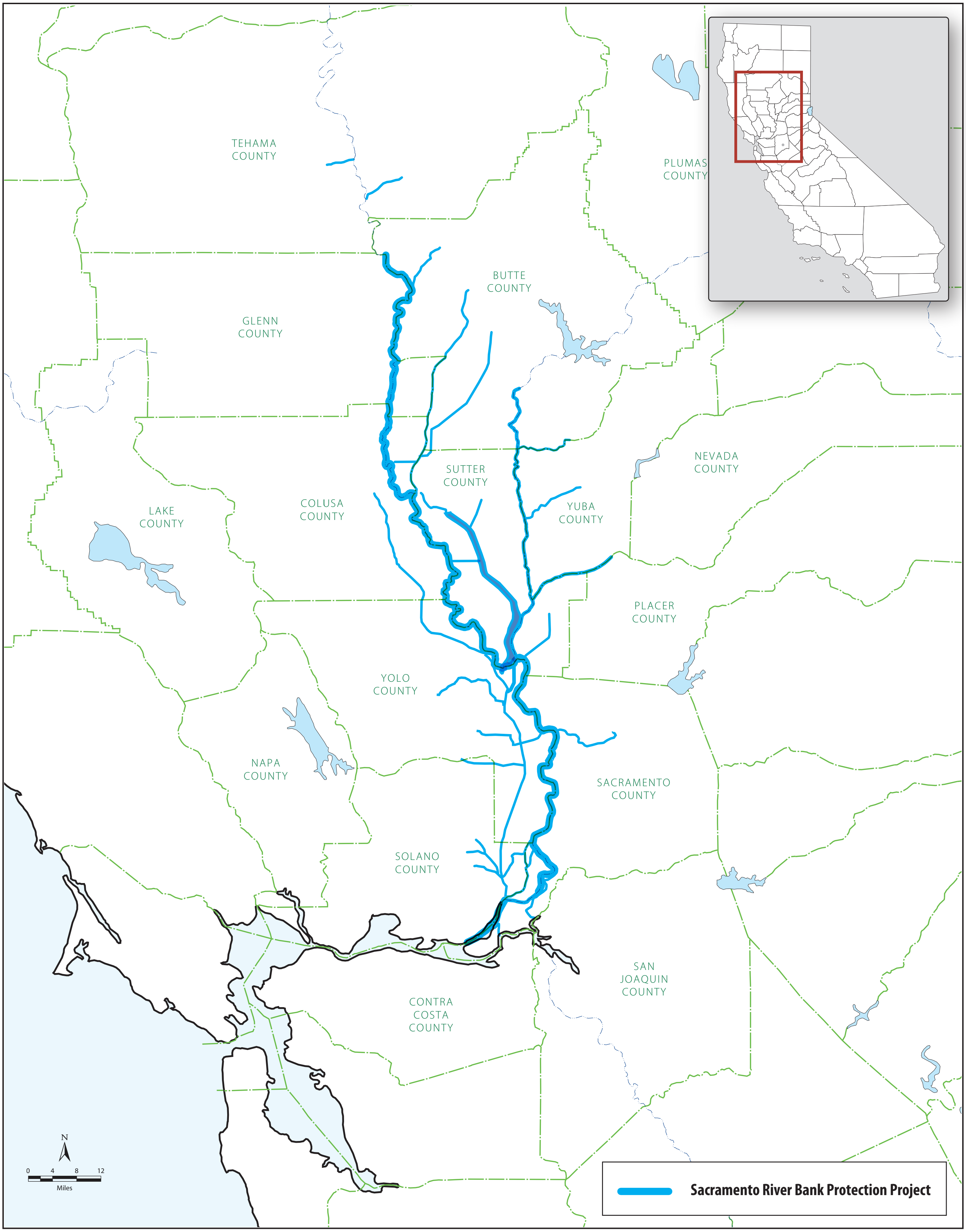


Figure 1-1
Program Vicinity

Graphics/Projects/06207.08 Sac Bank/EIS/EIR (06-13) SS

Lead Agencies

The State CEQA Guidelines provide that a lead agency under CEQA may work with a federal agency to prepare a joint document that will meet the requirements of both NEPA and CEQA. The NEPA regulations similarly encourage federal agencies to cooperate with local agencies “to the fullest extent possible to reduce duplication between NEPA and comparable State and local requirements,” including the preparation of a joint document (40 CFR Section 1506.2). A joint document cannot be prepared solely by a state or local agency. The federal lead agency under NEPA must be involved in the preparation of the joint document (40 CFR Section 1506.2; CEQA Guidelines Section 15222).

The SRBPP is a local cooperation project with the U.S. Army Corps of Engineers, Sacramento District as the federal participant responsible for implementation of the SRBPP with its non-federal partner, the CVFPB, the state agency designated for non-federal responsibilities and cost sharing. The Corps (NEPA lead agency) and the CVFPB (CEQA lead agency) (referred to herein as Lead Agencies) have determined that a joint programmatic EIS/EIR is the most appropriate means to comply with both NEPA and CEQA because of the need for coordination among federal and state agencies, and the need to complete environmental review as expeditiously as possible.

Project Purpose and Objectives

The central reaches of the Sacramento River levees in the SRFCP were established close to streambanks to erode vast sediment deposits accumulated from hydraulic mining in the Sierra Nevada during the 1800s and to facilitate use of rich floodplain soils for agriculture. This sediment-removal purpose was met by about 1940, but the rivers, deprived of the natural energy dissipation of floodplains, have continued to erode laterally, often undermining the toe of adjacent levees. This ongoing problem has two potential solutions as authorized under the Sacramento River Bank Protection Project (The River Basin Monetary Authorization Act of 1974, Pub. L. 93-251, Section 202): setback of levees to reduce floodflow depths and velocities and thus erosion of banks, or armoring existing or restored streambanks to resist the erosion.

The program purpose and objective is to arrest or avoid streambank erosion that threatens the integrity of the SRFCP levee system. To protect property, as well as the health and safety of residents, bank repair and levee rehabilitation are needed at erosion sites. The proposed program will also attempt to greatly minimize erosion, limiting the eventual loss of nearshore aquatic habitat and riparian habitat that would likely occur if the proposed program were not enacted.

Need for Action

Implementation of the SRBPP and 80,000 LF of additional bank protection would ensure the continued integrity of the SRFCP levees while protecting environmental resources and compensating for effects on significant environmental resources to the degree feasible. Levees within the program area provide flood damage risk reduction for the Sacramento Valley and help convey water flowing from the surrounding mountain ranges to the Delta. Levees with eroded banks can weaken and fail, especially when stressed by high winter flows, boat wakes, and waves from wind; to maintain the integrity of the flood control system, locations with a high failure potential would be identified and remedied through project implementation.

As part of the annual field reconnaissance reviews of the SRFCP, the Corps and its local sponsor, the CVFPB, have found that the number of documented bank erosion sites in the inventory is increasing. Specifically, the total number of erosion sites for the SRFCP increased from 152 in 2007 to 201 in 2012, despite some sites being repaired and status changes of other sites between the inventories (Ayres Associates 2008:5 and U.S. Army Corps of Engineers 2013:27).

Background of Purpose and Need

Original Authorization (Phase I)

The SRBPP is a continuing construction program, originally authorized by the Flood Control Act of 1960, to provide protection for the existing levees and flood control facilities of the SRFCP (Pub. L. 86-654, Section 203). The SRFCP consists of more than 1,000 miles of levees, plus overflow weirs, pumping plants, and bypass channels that protect communities and agricultural lands in the Sacramento Valley and the Delta.

The SRFCP was originally constructed pursuant to the Flood Control Act (Pub. L. 64-367, Section 2, 39 Stat. 948, 949 [1917]), which Congress enacted on March 1, 1917. Congress first authorized the Corps to provide substantial support for ongoing flood protection as applied to the existing SRFCP in 1960 (Flood Control Act, Pub. L. 86-654, Section 203, 74 Stat. 498 [1960]).

By 1960, the federal government began to see the national value in investing funding in large-scale flood protection projects in complicated watersheds. In the Flood Control Act of 1960, Congress authorized substantial support for flood protection for the Sacramento River Basin (Pub. L. 86-654, Section 203). This constituted Phase I of the SRBPP. Phase I was constructed from 1963 to 1975 and consisted of 435,953 linear feet of levee repairs.

In 1972, the Chief of Engineers found that "[a]lthough work under the initial phase [Phase I] has effectively controlled erosion at the critical sites, each year stream banks and levees at additional unprotected locations throughout the SRFCP are subject to erosion" (U.S. Army Corps of Engineers 1972).

Project Reauthorization (Phase II)

Accordingly, in 1974, repair of 405,000 LF was authorized in the River Basin Monetary Authorization Act of 1974 (Pub. L. 93-252, Section 202, 88 Stat. 49 (1974)). The portion of the SRBPP completed pursuant to the 1974 authorization is identified in this document as Phase II of the SRBPP. Construction began in 1976 under Phase II, and current bank protection is being carried out under the original Phase II authorization. Only about 4,966 LF of authorization remain after the 2012 construction season and plans are under development to construct this additional increment.

Phase II Supplemental Authority (Proposed Program)

Through Section 3031 of the Water Resources Development Act of 2007 (Pub. L. No. 110-114, Section 3031) an additional 80,000 LF was authorized as a continuation of Phase II bank protection. In 2008, the Corps' Sacramento District initiated development of a program of action for this work as set forth in the SRBPP authorization and associated reports of the Chief of Engineers, the Corps' planning process described in Engineer Regulation 1105-2-100 (Planning Guidance Notebook) and technical engineering design documents, NEPA, the federal Endangered Species Act, and other relevant environmental laws. A Limited Reevaluation Report (LRR) for the additional 80,000 LF needs to be finalized and approved prior to construction. Approval of the LRR and implementation of the program is dependent on compliance with NEPA and CEQA and other environmental laws.

The existing SRBPP provides for a continuing long-range program of bank stabilization and erosion control to maintain the integrity of the SRFCP through bank protection and setback levees.

The LRR will contain a programmatic plan using 106 representative erosion sites. The selection of these representative sites was informed by the 2008 Field Reconnaissance Report, which lists and prioritizes possible bank protection sites. In the 2008 Field Reconnaissance Report, 154 erosion sites were identified that may or may not receive bank protection under Phase II. The Corps selected 106 of these sites as a representative sample for the LRR and EIS/EIR analyses. These 106 sites exhibit bank and levee conditions that are threatening the function of the flood control system (see discussion of Erosion Sites in Chapter 2, Project Description). As new sites are identified and existing sites may change from year to year, actual selection of sites will depend on the current annual inventory at time of selection. The report lists sites that are scattered along levees on the main Sacramento River, from Collinsville (River Mile [RM] 3) to Chico Landing (RM 194 [while the levees end at RM 184]), and tributaries of the Sacramento River. These tributaries include the American River, the Feather River, the Bear River, the Yuba River, and Cache Creek.

Although the SRBPP Phase II 80,000 LF will consist of individual bank protection sites on SRFCP levees, specific sites are not identified or analyzed as part of this programmatic EIS/EIR. This EIS/EIR analyzes environmental impacts of constructing 80,000 LF of bank protection on SRFCP levees and increasing the Phase II authorization from 405,000 to 485,000 LF.

Related Flood Risk Reduction Activities

The proposed program would be implemented in coordination with other activities that overlap with, and are closely linked to, the SRFCP (Figure 1-2). These and other projects are briefly described below.

Public Law 84-99 Rehabilitation Assistance of Flood Control Works

Lead Agencies: Corps, CVFPB, California Department of Water Resources (DWR).
The Flood Control and Coastal Emergency Act (Pub. L. 84-99 69 Stat. 186 (1955) (codified as amended at 33 United States Code [USC] 701n) focuses on the repair of levees damaged by specific flood events that were declared emergencies. Under this federal statute, the Corps and DWR are authorized to conduct emergency repairs to flood management works threatened or destroyed by high-water events, such as California's 1997 and 2006 floods. All systems considered eligible for PL 84-99 rehabilitation assistance have to be in the Rehabilitation and Inspection Program prior to the flood event. Acceptable operation and maintenance by the public levee sponsor are verified by levee inspections conducted by the Corps on a regular basis. PL 84-99 sites are prioritized by order of urgency, ranging from the most urban (order 1 sites) through the most rural (order 5 sites).

Bay Delta Conservation Plan

Lead Agency: DWR, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS).

The Bay Delta Conservation Plan (BDCP) is a part of California's overall water management portfolio. It is being developed as a 50-year habitat conservation plan with the goals of restoring the Sacramento-San Joaquin Delta ecosystem and securing California water supplies. The BDCP would secure California's water supply by building new water delivery infrastructure and operating the system to improve the ecological health of the Delta. The BDCP also would restore or protect approximately 150,000 acres of habitat to address the Delta's environmental challenges.

The public review Draft EIR/EIS was made available for public review and comment from December 13, 2013 through July 29, 2014. On August 27, 2014 DWR and the other state and federal agencies leading the BDCP announced that they will publish a partially Recirculated Draft BDCP, EIR/EIS, and Implementing Agreement (IA) in early 2015. The recirculated documents will include those portions of each document that warrant another public review prior to publication of final documents. All substantive comments received on the Draft EIR/EIS and partially recirculated Draft EIR/EIS prior to the comment period deadlines will be considered in the Final EIR/EIS and decision-making process. No final decisions have been made regarding going forward with the BDCP or in selecting an alternative; those decisions will only occur after the completion of the CEQA and NEPA processes.

Interagency Flood Maintenance Collaborative Program

Lead Agency: DWR.
The purpose of DWR's Interagency Flood Maintenance Collaborative Program is to engage in an interagency collaboration that results in short-term, intermediate-term, and long-term actions to more systematically and effectively manage the flood control system in the Central Valley. The new approach includes improving the permit processes and the way DWR does business to reduce the public's exposure to risks from flooding while incorporating environmental resource protection and enhancement. The approach should be regional, sustainable, and predictable over the long term, preserved in procedural and organizational changes, and result in flood system efforts that advance and integrate the missions and goals of the agencies participating in this process.

California Levee Stability Program

Lead Agencies: Corps, DWR.
This program is designed to quickly implement high-priority levee reconstruction projects to reduce the risk of catastrophic levee failure in the Delta. In addition to flood control, the program considers ecosystem restoration opportunities.

Natomas Levee Improvement Project

Lead Agencies: DWR, CVFPB, Sacramento Area Flood Control Agency (SAFCA).
As part of its long-term program to improve the Natomas Basin levee system, SAFCA is continuing waterside and landside levee-strengthening efforts, including levee raises, seepage remediation, increased bank protection, levee stabilization, and flattening of landside levee slopes under the Natomas Levee Improvement Project (NLIP). The NLIP is an Early Implementation Program (EIP) under state law. It is also a Federal action under Clean Water Act Section 408 (33 USC Section 408).

The ultimate goal of the NLIP is to provide the Natomas Basin with a 200-year level of flood protection by improving conditions along approximately 26 miles of levees surrounding the Natomas Basin. These levees are the Natomas Cross Canal South Levee, Sacramento River East Levee, American River North Levee, Natomas East Main Drainage Canal West Levee, and the

State Plan of Flood Control

Lead Agency: DWR
Location: Central Valley
Goal: Guide flood management expenditures under Propositions 84 & 1E
Timeline: Complete Plan by 2014

Sacramento – San Joaquin River Basins Comprehensive Study

Lead Agency: USACE and DWR
Location: Central Valley
Goal: Flood damage reduction and ecosystem restoration
Phase: Study completed in 2002; laid groundwork for several current efforts, including State Plan of Flood Control

Sutter Basin Feasibility Study

Lead Agency: USACE, CVFPB and SBFCA
Location: Sutter and Butte counties
Goal: Reduce flood risk for communities in Sutter and Butte counties
Phase (Timeline): Feasibility Study and EIS (2013)

Natomas Levee Improvement Program

Lead Agency: SAFCA
Location: Natomas Area, Sacramento
Goal: Achieve 200-year flood protection for the Natomas Basin
Timeline: Construct 100-year protection by 2014, 200-year protection by 2016

West Sacramento Levee Improvements Program

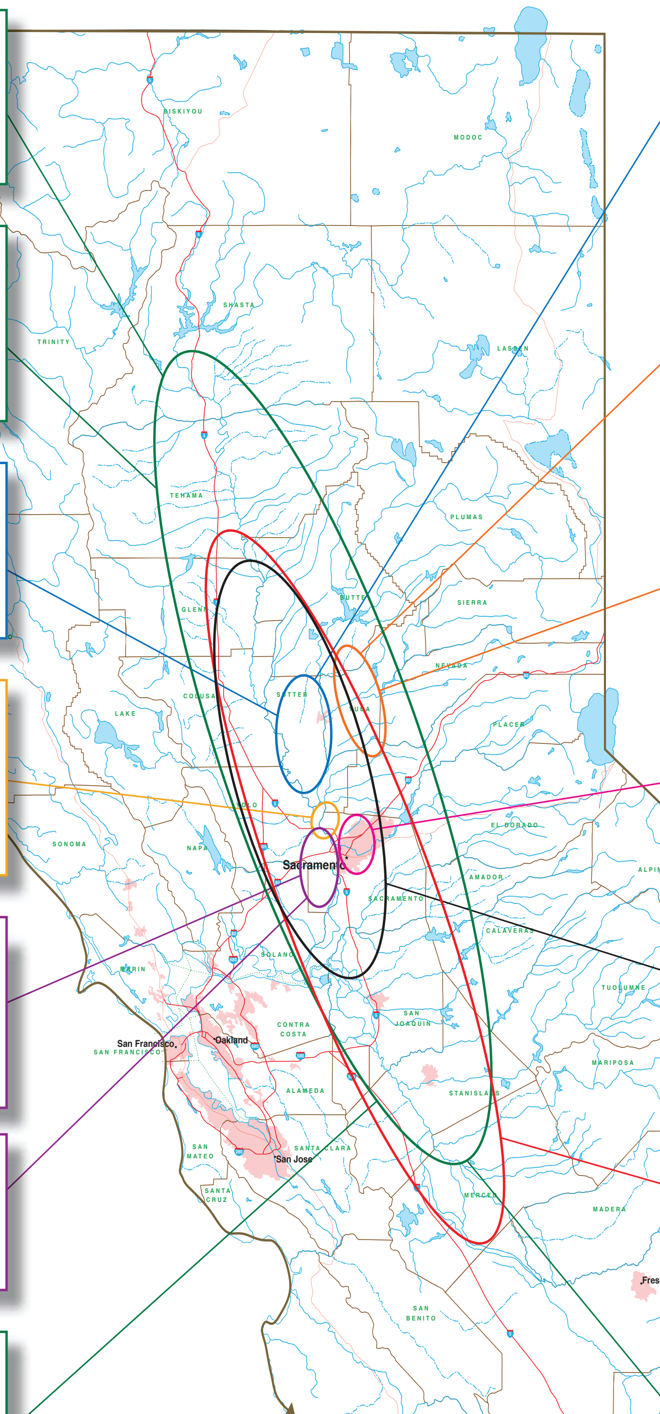
Lead Agency: WSAFCA
Location: West Sacramento
Goal: Achieve 200-year flood protection for the City of West Sacramento
Phase (Timeline): 3 projects completed in 2008 and 2011; next project targeted to begin construction in 2014

West Sacramento Project

Lead Agency: USACE, CVFPB, and WSAFCA
Location: West Sacramento
Goal: Comprehensive analysis of the City's levee system
Phase (Timeline): GRR (2015)

Central Valley Flood Protection Plan

Lead Agency: DWR and CVFPB
Location: Central Valley and Sacramento-San Joaquin Delta
Goal: Develop strategies for comprehensive system-wide flood improvements
Timeline: Plan adopted in 2012; complete protection measures by 2025



Feather River West Levee Improvement Project

Lead Agency: USACE, State of California, and SBFCA
Location: Sutter and Butte Counties
Goal: Achieve 200-year protection for urbanized areas and 100-year protection for agricultural areas
Timeline: Construction 2013-2015

Yuba Basin Project

Lead Agency: USACE, DWR, and YCWA
Location: Yuba, Feather, Bear rivers Watershed
Goal: Increase flood protection for communities of Linda, Olivehurst, Arboga, Marysville, and unincorporated areas of Yuba County
Phase (Timeline): GRR (2013)

Three Rivers Levee Improvement Authority Projects

Lead Agency: TRLIA
Location: Southern Yuba County
Goal: Increase flood protection for communities in southern Yuba County
Phase (Timeline) The work was completed in 2010

American River Common Features Project

Lead Agency: USACE, DWR, and SAFCA
Location: Sacramento metropolitan area
Goal: Reduce flood risks for the City of Sacramento
Phase (Timeline): GRR (2013)

Sacramento River Bank Protection Project

Lead Agency: USACE and DWR
Location: SRFCP
Goals: Federal program to correct levee erosion issues
Phase (Timeline): Phase II EIS (2013)

PL 84-99 Rehabilitation Assistance of Flood Control Works

Lead Agency: USACE and DWR
Location: Central Valley and Sacramento-San Joaquin Delta
Goals: Federal program to provide emergency levee repairs
Timeline: Ongoing

Levee Collaborative

Lead Agency: USACE and DWR
Location: Central Valley
Goals: Develop short- and long-term plans to achieve system-wide compliance with Corps standards for the State Flood System in the Central Valley
Timeline: Ongoing

ACRONYMS

WSAFCA - West Sacramento Area Flood Control Agency
USACE - U.S. Army Corps of Engineers
SBFCA - Sutter-Butte Flood Control Agency
DWR - Department of Water Resources
SAFCA - Sacramento Area Flood Control Agency
SRFCP - Sacramento River Flood Control Project
YCWA - Yuba County Water Agency
CVFPB - Central Valley Flood Protection Board
TRLIA - Three Rivers Levee Improvement Authority

Figure 1-2
Major Flood Risk Reduction Efforts in the Sacramento Valley

Pleasant Grove Creek Canal West Levee. The NLIP is a four-phase construction program: Phase 1 occurred in 2008, Phase 2 in 2009 and 2010, Phase 3 in 2010 and 2011, and a majority of Phase 4a work was completed in 2011 with the remainder in 2012. Phases 1 through 4a focus on the Natomas Cross Canal South Levee and a large portion of the Sacramento River East Levee.

Portions of work under Phases 3, 4a, and 4b along the Sacramento River East Levee, the American River North Levee, the Natomas East Main Drainage Canal West Levee, the Pleasant Grove Creek Canal West Levee, and water supply and drainage pump station improvements are still needed but have been deferred from SAFCA's EIP construction program. The Corps completed the Post Authorization Change Report and Interim General Re-evaluation Report, American River Common Features Project, Natomas Basin, Sacramento and Sutter Counties, California study and an approved Chief's report. In 2014, the project received congressional authorization as part of the 2014 Water Resources Reform and Development Act. With congressional authorization, SAFCA is working with the state and Corps to continue implementation of the NLIP.

American River Common Features Project

Lead Agencies: Corps, CVFPB, DWR, SAFCA.
To increase flood protection for the city of Sacramento, which is bordered by the left bank of the Sacramento River, the American River Common Features Project (Common Features) was authorized by Congress in the WRDA of 1996 (Pub L. No. 104-303, Section 101(a)(1), 110 Stat. 3658, 3662–3663 (1996)). This authorization called for strengthening the north and south levees of the American River and raising and strengthening the upper 12 miles of the left levee of the Sacramento River in the Natomas area, just north of the city of Sacramento. These improvements were considered "common features" of any comprehensive plan of flood protection for the Sacramento area that might ultimately be approved by Congress. In the WRDA of 1999 (Pub. L. No. 106-53, Section 366, 113 Stat. 269, 319-320 (1999)), the scope of the Common Features authorization was expanded to include raising portions of the north and south levees of the American River (including the Mayhew Levee), strengthening portions of the north levee of the American River, and raising and strengthening the north and south levees of the Natomas Cross Canal in the Natomas area.

With the goal of strengthening the American River levees to enable them to pass a flow of 160,000 cubic feet per second (cfs), the Common Features project has installed roughly 24 miles of slurry wall up to depths of 80 feet, raised levees to provide adequate freeboard, addressed slope stability issues, and corrected some erosion problems. Because of the considerable cost increase of seepage remediation on the American River, all funds appropriated by Congress throughout the late 1990s and the early part of the 2000s were used for construction activities on the American River instead of for design efforts for the Natomas Basin. In 2006, the Common Features authorization was deemed sufficient to cover improvements to the left levee of the Sacramento River near the Pioneer Reservoir and in the Pocket/Freeport area.

The Corps is currently conducting a post-authorization change stud y of the Common Features project. Under this study, the Corps is reevaluating the previous Common Features project and identifying levee improvements needed to provide the city of Sacramento and the Natomas area to the north with at least a 200-year level of flood protection. The Corps uses General Reevaluation Reports (GRR) to present the results of a reevaluation of a previously completed study, using current planning criteria and policies, which is required due to changed conditions and/or assumptions (Engineer Regulation 1105-2-100). The results may reaffirm the previous plan, reformulate and modify it, or find that no plan is currently justified. The results are documented in a

GRR which, if recommended and supported, also serves as the decision document for a Federal action.

The Common Features GRR is planned for completion in 2015. Construction associated with the report would begin approximately 1 year after adoption of the report by Congress. Much of this work was completed or is underway by SAFCA as an EIP and Section 408 action. The Natomas Post-Authorization Change Report documents the evaluation of features in the Natomas Basin portion of the Common Features project and was submitted to Congress in October 2010 and obtained congressional authorization in 2014.

Delta Levees Flood Protection Program

Lead Agency: DWR.
This is a grant program that works with more than 60 reclamation districts in the Delta and Suisun Marsh to maintain and improve the flood control system and provide protection to public and private investments in the Delta, including water supply, habitat, and wildlife. The program, through its two major components of Delta Levees Maintenance Subventions Program and Delta Levees Special Flood Control Projects, works with local agencies to maintain, plan, and complete levee rehabilitation projects. One of the requirements to qualify for available funds is for the project to result in no net loss of Delta habitat.

Lower Feather River Corridor Management Program

Lead Agency: DWR.
The Lower Feather River Corridor Management Plan (LFRCMP) describes a long-term vision and multi-objective strategy for managing the 20-mile-long Feather River corridor between the Marysville and Yuba City urban areas in the north and the Sutter Bypass in the south. The LFRCMP provides a vision for how flood system maintenance and habitat enhancement can be integrated under long-term programmatic permits, as well as recommendations for optimizing future management, restoration, and maintenance of the corridor. It provides a planning tool and informational resource for flood managers at DWR and local maintaining agencies, as well as resource agencies, environmental and recreation advocates, farmers, and the general public. The LFRCMP was released in June 2014.

Levee Repairs Program

Lead Agency: DWR.
The Levee Repairs Program is a state-run program to repair erosion sites throughout the Central Valley flood control system. The program was implemented in response to the governor's declaration of a state of emergency for California's levee system in 2006. To determine the most critical sites for repair, DWR evaluated more than 50 sites along the SRFCP, including 29 critical erosion sites in need of urgent repairs.

Mid-Valley Levee Reconstruction Project

Lead Agencies: Corps, DWR.
This project reconstructs deficient levees of the SRFCP in the Mid-Valley area (between the Tisdale Bypass and the Sacramento Bypass) to their original design standard. The scope includes construction of stability berms, slurry walls, and toe drains.

Sacramento River Flood Control System Evaluation

Lead Agency: Corps, CVFPB, DWR.
Following the flood of 1986, the Corps and the state, along with local partners, completed a comprehensive evaluation of the Sacramento River Flood Control System and initiated a flood risk management program aimed at repairing, raising, and strengthening urban levees, among other activities. This effort, known as the Sacramento River Flood Control System Evaluation (commonly referred to as System Evaluation), resulted in the repair of more than 70 miles of deficient levees by the Corps. However, to date, not all the authorized repairs have been completed. Moreover, the completed repairs were built to standards that were in place at the time and which are no longer current.

Due to the large scale of the evaluation, the review was split into five phases. The results were published in the Sacramento River Flood Control System Evaluation, Phase II–V, Programmatic EIS/EIR, dated May 1992. Phases I and II evaluations include the Sacramento urban area and Marysville/Yuba City area. Phase III concerns the Mid-Valley area in and around the town of Knights Landing, approximately 27 miles northwest of Sacramento. Phase III involves reconstructing deficient levees of the SRFCP in the Mid-Valley area (between the Tisdale Bypass and the Sacramento Bypass) to their original design standard. The scope includes construction of stability berms, slurry walls, and toe drains.

Phases IV and V include the lower Sacramento River area south of Sacramento and the upper Sacramento River area north of Knights Landing. According to the November 2002 SRFCP Limited Reevaluation Report (LRR), Phase VI was added to evaluate additional potential sites in all phases, but its supplemental design memorandum had not been completed at that time.

Phase III is the only currently active phase and is being designed for dike slurry wall work at three sites along the right bank of the Sacramento River (River Mile [RM] 84.1 to 87.2). The work also involves dike reconstruction, with final design being recently completed, at three sites along the left bank of the Knights Landing Ridge Cut. The state is proposing to complete the Knights Landing work under an EIP; otherwise, the Corps would complete all work in 2015 to 2016.

Sutter Basin Feasibility Study

Lead Agency: Corps, State of California, and Sutter Butte Flood Control Agency (SBFCA).
The Sutter Basin is bounded roughly by the Feather River, Cherokee Canal, Sutter Buttes, and the Sutter Bypass, and contains the cities of Gridley, Live Oak, Biggs, and Yuba City, as well as a significant amount of agricultural land. Past flood events and geotechnical analysis show that the levees bordering the Sutter Basin (including the Feather River West Levee) have a higher probability of failure related to through-and under-seepage than levees designed to meet current standards. Additionally, the levees are at risk of overtopping from floods greater than the levees are designed to withstand. The Sutter Basin project may eventually provide the Sutter Basin with 100- to 200-year flood protection (depending upon location).

The Corps completed a Feasibility Study of the Sutter Basin in 2013. The Feasibility Study evaluated structural and nonstructural flood risk management measures, including reoperation of existing reservoirs; improvements to existing levees; construction of new levees; and other storage, conveyance, and nonstructural options. Ecosystem restoration measures were also investigated, including restoration of floodplain function and habitat. The Corps released a Final Integrated

Feasibility Report and Supplemental EIS/EIR in June 2013. In 2014, the project received congressional authorization as part of the 2014 Water Resources Reform and Development Act.

Feather River West Levee Improvement Project

Lead Agency: Corps, State of California, and SBFCA.
Levee improvements are underway by SBFCA to reduce flood risk in portions of Sutter and Butte Counties. The projects are intended to achieve a minimum 200-year protection for urbanized areas and 100-year for agricultural areas by addressing flood management deficiencies on the Feather River West Levee. The deficiencies include risks from through-seepage and under-seepage relative to federal and state levee criteria. The current project addresses the 41 miles downstream of Thermalito Afterbay to approximately 4 miles upstream of the confluence of the Feather River with the Sutter Bypass. The proposed measures include cutoff walls, seepage berms, and slope flattening. Construction was initiated in 2013 and is scheduled to be completed in 2015. The project is funded by local dollars provided by a parcel assessment district and state bonds from Propositions 84 and 1E, ultimately seeking Federal credit.

Sacramento–San Joaquin River Basins Comprehensive Study and Central Valley Integrated Flood Management Study

Lead Agency: Corps.
Following the 1997 flood, the Sacramento–San Joaquin River Basins Comprehensive Study (Comp Study) was initiated by the state and the Corps to formulate comprehensive plans for flood risk reduction and environmental restoration. This study was unable to stimulate widespread public or political interest in flood risk reduction or environmental restoration activity beyond the ongoing urban levee improvement programs. The study did result in a new set of engineering criteria for the design and evaluation of urban levees and a greatly expanded scope for the ongoing urban levee improvement efforts on the Sacramento and American Rivers. In addition, the adequacy of previous repairs was reviewed.

Presently, the Central Valley Integrated Flood Management Study (CVIFMS) is a continuation of the Comp Study in which the Corps and the state are defining a long-range program for the Sacramento and San Joaquin River Basins and the corresponding level of federal participation. CVIFMS will evaluate flood risk management improvements in the Central Valley from a Federal perspective, and provide a framework for authorization and implementation of flood risk management projects in the Central Valley. This program will identify opportunities to reduce flood risk by improving the flood capacity of the system while restoring and protecting floodplain and environmental features, including wetlands and other fish and wildlife habitat. The approaches and management strategies under CVIFMS include these measures.

- Conduct a watershed study to provide long-term reduction of flood risk and environmental restoration needs.
- Coordinate closely with Central Valley Flood Protection Plan (CVFPP) development to produce joint products for mutual benefits and use.
- Provide leadership in specific disciplinary areas to ensure consistency in national management directives and guidelines.
- Coordinate with ongoing projects and programs to incorporate relevant information and actions in the study development.

Following completion of CVIFMS, it is anticipated that several regional feasibility studies will be completed. When completed, the feasibility studies will be used to determine Federal interest in implementing elements of the CVFPP and identify non-Federal responsibilities for improvement to the system.

State of California Central Valley Flood Protection Plan

Lead Agency: DWR, CVFPB.
The Central Valley Flood Protection Act (CVFPA), enacted in California in 2009, called for DWR to present a CVFPP by January 1, 2012 to the CVFBP. The CVFPP outlines a comprehensive system-wide approach for the protection of lands currently protected from flooding by the SRFCP and the corresponding San Joaquin River watershed to the south. It also establishes a new standard of 200-year flood protection for urban areas in the Central Valley and requires this standard to be achieved by 2025.

The CVFPP presents three preliminary approaches for addressing current challenges and affordably meeting the CVFPP goals. The state has assembled what it views as the most promising, affordable, and timely elements of the three preliminary approaches into the State Systemwide Investment Approach (SSIA), which provides guidance for future state and local participation in projects and programs for integrated flood management in the Central Valley. The CVFPB adopted the CVFPP in June 2012. This plan is part of the State of California FloodSAFE program. FloodSAFE is a multifaceted program with an emphasis on better managing flood risk throughout California and focused on the state-federal flood protection system in the Central Valley.

DWR has initiated two basin-wide feasibility studies—Regional Flood Management Planning and the Central Valley Flood System Conservation Strategy—to advance both ongoing and long-term implementation of the SSIA. The basin-wide feasibility studies will incorporate findings and data from many ongoing DWR efforts. The Conservation Strategy will provide the systemwide context for improving environmental conditions and trends throughout the flood management system as a whole, reducing compensatory mitigation needs for individual projects and developing efficient permitting strategies for CVFPP implementation. DWR plans to actively engage locally-led regional flood management planning efforts to ensure that information developed through systemwide planning is available for regional plan development. Similar feedback from regional flood management planning efforts will provide local perspectives and inform the analysis of systemwide flood management and conservation elements. Each of these planning efforts will be incorporated into the next update of the CVFPP, which is scheduled for 2017. Implementation of CVFPP actions have already begun and will be expanded after the 2017 Plan is updated.

Yuba Basin Project

Lead Agencies: Corps, DWR.
The Yuba Basin Project is an initiative to provide a 200-year level of protection and higher for communities in Yuba County. When complete, it will be the first community in California's Central Valley to achieve the state's requirement of 200-year flood protection.

To accelerate this federally authorized project, the state and local interests (Yuba County, Yuba County Water Agency, and Three Rivers Levee Improvement Authority [TRLIA]), began an advanced levee construction program in the southern portion of the county. Work is now complete on all of the 29.3 miles of levees, including the construction of two new setback levees: the 2-mile long Bear

River setback and the 6-mile long Feather River setback. Besides providing greater regional flood protection, these setback levees resulted in the creation of nearly 2,000 acres of wildlife habitat. The scheduled work for the 7.5-mile long Marysville Ring Levee is the final piece to the entire project.

Three Rivers Levee Improvement Agency Levee Improvement Program

Lead Agency: TRLIA.
TRLIA, a joint powers agency, was established in May 2004 by Yuba County and Reclamation District (RD) 784 to finance and construct levee improvements in south Yuba County. The goal of the Three Rivers Levee Improvement Program is to provide 200-year flood protection to more than 40,000 residents in Linda, Olivehurst, and Plumas Lake. Four work phases, covering 29 miles of levees, were identified to achieve this goal. All of the work identified in the four phases has been completed as of the end of 2011, and TRLIA is currently conducting only minor studies.

The levees affected by this project are the south levee of the Yuba River, the east levee of the Feather River, the north levee of the Bear River, and the west levee of the Western Pacific Interceptor Canal. Improvements included stability berms, slurry cutoff walls, erosion protection, corrections to levee geometry, levee height increases, relief wells, monitoring wells, and detention basins. Setback levees were constructed along a portion of the Bear River north levee and the Feather River east levee. The land within the setback areas of both levees totals 1,750 acres, and will be used for habitat restoration and agricultural purposes.

West Sacramento General Reevaluation Report

Lead Agencies: Corps, DWR, West Sacramento Area Flood Control Agency (WSAFCA).
The Corps and DWR published the previous Sacramento Metropolitan Area General Reevaluation Report in 1992. The purpose of that report was to recommend a program of improvements needed to remedy structural problems and limitations of the levee system that were revealed by the 1986 flood. The subsequent 1997 flood and revisions to Corps levee construction standards after the 2005 New Orleans flood shifted attention to under-seepage deficiencies that had not been considered in the previous study. Presently, the Corps and WSAFCA are developing a GRR for West Sacramento levee improvements to assess the entirety of the levees protecting the city of West Sacramento in light of most recent criteria and knowledge regarding levee design, with particular attention to remediation of seepage deficiencies.

The primary objective of the West Sacramento GRR is to determine the extent of federal interest in additionally reducing the flood risk within the study area while concurrently exploring opportunities to increase recreation and restore the ecosystem along the Sacramento River within the study area. Much of this work was completed or is underway by WSAFCA as an EIP and Section 408 action (see discussion of the West Sacramento Levee Improvements Program below). Initiated in March 2009, the GRR is expected to be presented to Congress for authorization in 2015.

West Sacramento Levee Improvements Program

Lead Agency: WSAFCA.
The goal of the program is to achieve 200-year flood protection for the city of West Sacramento. WSAFCA proposes to implement a portion of the program, known as the Southport project, along the right bank of the urbanized reach of the Sacramento River as an EIP and Section 408 action. The study reach is approximately 6 miles, beginning at the upstream limit where a new SRBPP setback

levee terminates south of the barge canal connecting the Sacramento River to the Sacramento River Deep Water Ship Channel and extending downstream to the West Sacramento city limit at the South Cross Levee. The project would most immediately protect the part of the city known as Southport and is targeted at addressing under-seepage, through-seepage, erosion, and slope instability. This project is presently undergoing design development and an EIS/EIR is being prepared with the Corps as the federal lead agency based on the Corps' responsibilities under Clean Water Act Section 408 (33 USC Section 408) and Rivers and Harbors Act Section 10 (33 USC Section 403), and construction is anticipated to begin in 2015. WSAFCA's Southport project is being coordinated with the ongoing West Sacramento Project GRR (described previously). This project follows three others implemented by WSAFCA as EIPs and Section 408 actions, namely, the I Street Bridge project (completed in 2008) and the CHP Academy and The Rivers projects (completed in 2011).

Public Involvement and Agency Coordination

The Lead Agencies are implementing a comprehensive public participation program to fully inform and engage potentially affected agencies, stakeholders and communities.

Notice of Preparation/Notice of Intent Scoping

In January 2009, the Lead Agencies issued a Notice of Preparation (NOP) of an EIR and a Notice of Intent (NOI) to prepare an EIS, informing agencies and the general public that an EIS/EIR was being prepared and inviting comments on the scope and content of the document during the 45-day public review period. The NOI and NOP also requested participation at public scoping meetings. Appendix A includes the NOI as published in the Federal Register on January 30, 2009, and the NOP as distributed to responsible agencies and interested parties. In February 2009, the Lead Agencies hosted four public scoping meetings in Colusa, Walnut Grove, Sacramento, and Chico. Comment letters regarding the NOI and NOP and transcripts of the public scoping meetings also are included in Appendix A.

To publicize the scoping meetings, advertisements were placed in the *Sacramento Bee*, the Colusa County *Sun Herald*, and the *Chico Enterprise-Record*. Meeting notices were also sent to 68 resource agencies, 22 local media contacts, 18 tribal contacts, eight levee districts, and 124 reclamation districts inviting them to the meeting or to provide input about the proposed program during the scoping period. Copies of the advertisements and meeting notice can be found in Appendix A.

Additionally, a letter was sent to elected officials inviting their attendance at the public scoping meetings and input on the proposed program. The letter was sent to the following members of the House of Representatives: Wally Herger; Dan Lungren; Doris Matsui; Tom McClintock; Jerry McNerney; Ellen Tauscher; George Miller; and Mike Thompson.

Agency Consultation and Coordination

Consultations and coordination with numerous local, state, and federal agencies have been conducted throughout Phase II of the SRBPP. The regulatory setting for each respective resource chapter in this EIS/EIR describes applicable federal, state, regional and local laws and regulations. Appendix C, Regulatory Background, contains the discussion of the regulatory setting for each resource area. Additionally, Chapter 24, Compliance with Applicable Laws, Policies, Plans, and

Regulatory Framework, describes preliminary information on the major requirements for permitting and environmental review and consultation prior to implementation, including consultation to date with various agencies. The following is a summary of those coordination efforts.

Resource Agency Coordination

The Interagency Working Group (IWG) was formed as a term and condition of the draft (Jeopardy) and final Biological Opinions (BOs) previously issued by the USFWS and NMFS for Phase II. The IWG's primary purpose is to develop products for SRBPP planning, and to determine project impacts on listed species under the federal Endangered Species Act and coordinate related issues with state and federal natural resource agencies. Meetings are typically monthly and key participants include the Corps, CVFPB, DWR, USFWS, NMFS, and the California Department of Fish and Wildlife (DFW). Meetings have continued through the planning and Draft EIS/EIR processes.

In addition, between September 16, 2008 and November 25, 2008, the Corps solicited input from agencies that have a direct interest in flood risk management and the environmental conditions associated with future locations and types of bank protection alternatives. Interviews were conducted with staff of NMFS, California State Lands Commission (SLC), DFW, USFWS, Corps, DWR and CVFPB to better understand their perspectives and vision for implementation of the additional 80,000 LF of bank protection. The interviews resulted in several recommendations for improvement of the SRBPP planning and implementation process, which are presented in Appendix A.

Native American Consultation

On May 4, 2009, the Native American Heritage Commission (NAHC) was contacted to request a search of its Sacred Lands File. The NAHC staff responded on May 12, 2009 with a list of Native American contacts for Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties. Native American groups with potential interest in the area were identified through the efforts of an ethnographer. A series of letters, phone calls, emails and two workshops open to Native American groups in the spring of 2010 were used to further identify interested parties. Correspondence included a map depicting the program area, a brief description of the proposed program, and a request for the contacts to share any knowledge or concerns they may have regarding cultural resources in or adjacent to the program area. Based on this work, the Corps has initiated consultation with the following tribes.

- Berry Creek Rancheria of Tyme Maidu Indians
- Buena Vista Rancheria of Me-Wuk Indians
- Cachil DeHe Band of Wintun Indians of the Colusa Indian Community
- California Valley Miwok Tribe
- Cortina Band of Indians, Enterprise Rancheria (Estom Yumeka)
- Grindstone Rancheria
- Ione Band of Miwok Indians
- Mechoopda Indian Tribe of Chico Rancheria
- Mooretown Rancheria of Maidu Indians
- Paskenta Band of Nomlaki Indians, Redding Rancheria

- Shingle Springs Band of Miwok Indians
- United Auburn Indian Community of Auburn Rancheria
- Wilton Rancheria
- Yocha Dehe Wintun Nation (Rumsey Rancheria)

The Corps and DWR determined that development of a Cultural Resources Programmatic Agreement (PA) for the proposed program and an attending Historic Properties Treatment Plan (HPTP) would be the most effective way to comply with NEPA, Section 106 of the National Historic Preservation Act (NHPA), and CEQA. The PA and HPTP can be found in Appendix B. Further consultation with the tribes included requesting comments on the PA and HPTP, additional outreach meetings with individual tribes, and requesting their participation as concurring parties to the PA. To date, the California Valley Miwok Tribe, Mechoopda Indian Tribe of Chico Rancheria, and the Shingle Springs Band of Miwok have signed as concurring parties. Those tribes that have not signed as concurring parties to the PA will still be given an opportunity to comment on specific construction projects as they are designed and planned.

CEQA Responsible and Trustee Agencies

This EIS/EIR will be used by Responsible and Trustee Agencies to determine the effects of the proposed program. Responsible Agencies are those that have a legal responsibility to approve the program. These agencies are required to rely on the Lead Agency's environmental document in acting on whatever aspect of the proposed program requires the Responsible Agencies' approval but must prepare and issue their own findings regarding the program (CEQA Guidelines Section 15096). Trustee Agencies are those that have jurisdiction over certain resources held in trust for the people of California but do not have legal authority for approving or carrying out the proposed program. Responsible and Trustee Agencies for the proposed program are shown in Table 1-1.

Table 1-1. Responsible and Trustee Agencies

Agency	Jurisdiction
Trustee	
Department of Fish and Wildlife	Fish and wildlife Native plants designated as rare or endangered Game refuges Ecological reserves
State Lands Commission	State-owned "sovereign" lands
Responsible	
Office of Historic Preservation	Historic and cultural resources
Central Valley Flood Protection Board	Levee modifications
Air Resources Board	Air quality
Regional Water Quality Control Board (#5)	Discharges to water bodies

Draft Environmental Impact Statement/ Environmental Impact Report Public Comments

This EIS/EIR will be circulated for a minimum of 45 days for public review to federal, state, and local agencies; organizations; and individuals who have an interest in the project. A notice of availability of the draft EIS/EIR will be published in the Federal Register and local newspapers when the document is released for public review. Public workshops will be held during the review period to provide additional opportunities for comments on the draft document. Public notices will be sent providing public workshop details. All comments received during the public review period will be considered and incorporated into the final EIS/EIR, as appropriate. A comment and response appendix will be included with the final document.

Copies of the draft EIS/EIR will be submitted to the State Clearinghouse in Sacramento for distribution to state agencies. Additionally, the draft EIS/EIR will be available for public review on the SRBPP website (http://www.spk.usace.army.mil/Missions/CivilWorks/SacramentoRiverBankProtection.aspx) and CVFPB website (http://www.cvfpb.ca.gov/PublicNotices/).

Areas of Known Controversy and Unresolved Issues

CEQA Guidelines Section 15123(b) requires that an EIR describe areas of controversy known to the lead agency, including issues raised by agencies and the public as well as unresolved issues. NEPA regulations also require disclosure of areas of controversy and issues to be resolved (40 CFR Section 1502.12).

The following issue areas were identified during the NOI/NOP scoping period.

- Vegetation on levees.
- Economic impacts on rural communities.
- Hydraulic effects.
- Public outreach and agency coordination.
- Invasive species.
- Construction impacts, including routes for transporting materials.
- Effects on fish, wildlife, and vegetation, including Central Valley salmonids and bank swallow habitat.
- Erosion site locations and selection.
- Mitigation of impacts.
- Consideration of setback levees.
- Cumulative effects.
- Eminent domain as a possible tool for real estate acquisition.

Irreversible and Irretrievable Commitments of Resources/Significant Irreversible Environmental Changes

State CEQA Guidelines (14 California Code of Regulations 15126.2[c]) and NEPA (40 CFR Section 1502.16) require analysis of significant irreversible and irretrievable effects. CEQA requires evaluation of irretrievable resources to ensure that their use is justified. NEPA requires an explanation of which environmental impacts are irreversible or would result in an irretrievable commitment of resources.

Irreversible impacts are those that cause, through direct or indirect effects, use or consumption of resources in such a way that they cannot be restored or returned to their original condition despite mitigation. Potentially irreversible impacts are documented in this EIS/EIR. An irretrievable impact or commitment of resources occurs when a resource is removed or consumed. These types of impacts are evaluated to ensure that consumption is justified.

All the program alternatives would involve a commitment of a range of natural, physical, and fiscal resources as follows.

- Construction materials.
- Nonrenewable resources, such as gasoline and diesel oil used to power construction equipment and vehicles.
- Nonrenewable energy resources necessary to operate barges, trucks, and equipment used for construction, and operations and routine maintenance.
- Additional electrical power from a renewable resource for lighting and operations.
- Land conversion of open space, agricultural lands, and natural environments to other uses.

Any construction would require expenditure of state and federal funds for the costs of construction and right-of-way. The proposed program would also require funding for operation and maintenance of the constructed sites and for vegetation establishment and monitoring activities associated with mitigation elements.

The decision by the Lead Agencies to commit these resources is based on the concept that residents in the immediate area, region, and state would benefit from the implementation of the proposed program. The overarching benefit of the proposed program is that the integrity of the flood control system would be maintained through the application of site-specific bank protection measures to remedy erosion sites with high failure potential in order to prevent levee failure, catastrophic damage, and possible loss of life. Implementation of the SRBPP and 80,000 LF of additional bank protection would ensure the continued integrity of the SRFCP levees while protecting environmental resources and compensating for effects on significant environmental resources to the degree feasible. These benefits are expected to outweigh the commitment of these resources.

Relationship between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

The CEQ NEPA Regulations (40 CFR Section 1502.16) require that an EIS discuss issues related to environmental sustainability. In general, this EIS discussion is not considered an environmental effect for which either significance is defined, or mitigation is recommended. However, the discussion, as it relates to environmental consequences, must be included in the EIS, and should consider "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (42 USC Section 4332(C)(iv).

The short-term effects on and uses of the environment in the vicinity of the program area are related to long-term effects and the maintenance and enhancement of long-term productivity. *Short term* refers to the total duration of construction: the multi-year construction period to construct 80,000 LF of bank protection in the SRFCP area and associated mitigation elements to replace habitat losses. Construction associated with the proposed program, including implementation of various bank protection measures, would cause short-term impacts on the environment related to alteration of topography and hydrologic conditions, water quality, biological resources, air quality, land use, recreation, visual resources, and the human environment (noise and traffic conditions).

Long term refers to an indefinite period beyond the initial construction of the erosion sites and includes longer term and ongoing operation and maintenance of the sites as well as vegetation establishment and monitoring activities. Vegetation establishment and monitoring would be necessary to ensure that the vegetation required for mitigation is successfully establishing and that the vegetation is functioning as intended.

Implementation of the proposed program would include bank repair and levee rehabilitation, which would result in long-term benefits including protection of property and the health and safety of residents. The proposed river bank repair and mitigation work would greatly minimize erosion, limiting the eventual loss of nearshore aquatic habitat and riparian habitat that would likely occur if the proposed program were not enacted.

The No Action Alternative would offer none of the benefits and would likely cause substantially lesser impacts than those listed above. It would, however, do nothing to maintain the integrity of the flood control system by identifying and remedying locations with a high failure potential.

Chapter 2
Project Description

Introduction

The U.S. Army Corps of Engineers, Sacramento District (Corps) and the Central Valley Flood Protection Board (CVFPB) propose to implement the proposed program, which would result in the construction of an additional 80,000 linear feet (LF) of bank protection in the Sacramento River Flood Control Project (SRFCP) area. This chapter describes the proposed program components, provides a summary of the alternatives screening process and alternatives selected for analysis, and discusses physical and operational characteristics of the alternatives.

Project Location

The Sacramento River Bank Protection Project (SRBPP) area (also referred to as the program area) is located along the Sacramento River and its tributaries, distributaries and bypasses, and spans Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties in California (Figure 1-1). The alternatives covered in this programmatic EIS/EIR are those associated with future repair of bank erosion sites on an additional 80,000 LF within the program area.

Program Area

The program area extends along the Sacramento River from Collinsville at river mile (RM) 3, which is the southernmost point in the program area, upstream to Chico at RM 194, the northernmost point, and includes reaches of lower Elder and Deer Creeks. The program area also includes several tributary streams and distributary sloughs, including Cache Creek, the lower reaches of the American River (RM 0–13), Feather River (RM 0–61), Yuba River (RM 0–11), and Bear River (RM 0–17), as well as portions of Threemile, Steamboat, Sutter, Miner, Georgiana, and Cache Sloughs. Sutter and Yolo bypass levees are also included in the program area.

The economic analysis performed for the SRBPP PACR estimated that there are more than 193,000 structures protected by the SRBPP levees. The value of these structures and their contents (in 2012 dollars) is estimated at almost $100 billion. The SRBPP levees also protect more than 590,000 acres of agricultural land from flooding, with a damage potential of up to $630 billion depending on the severity of the flood event.

For the purposes of this EIS/EIR, the program area has been divided into four regions, organized south to north by the location of the downstream terminus of each watercourse with the mainstem Sacramento River (Figure 2-1). The four reaches are generally defined in a manner that captures the full range of environmental conditions within the program area while dividing them in a manner that recognizes differences in physical structure and species use among these four reaches. Region 1a includes the Yolo and Sacramento Bypasses, the Sacramento River below Isleton (RM 20), and a distribution network of sloughs and channels. Region 1b includes the mainstem Sacramento River from Isleton (RM 20) in the Delta, upstream past the city of Sacramento, to the Feather River confluence (RM 80) at Verona. Region 1b also includes the lower American River from the confluence with the Sacramento River upstream to RM 13, Natomas East Main Drain, Natomas Cross Canal, and Coon Creek Group Interceptor Unit 6. Within Region 2, the mainstem Sacramento River flows from Colusa (RM 143) downstream of the Colusa Bypass to the confluences with the Feather River and Sutter Bypass at Verona (RM 80). Region 2 also includes the lower Feather River from its confluence with the Sacramento River upstream to RM 61, the lower Yuba River from its confluence with the Feather River upstream to RM 5, and Bear River from its confluence with the Feather River upstream to the end of its levees above State Route 65. Region 3 includes the Sacramento River downstream of Chico Landing (RM 194) to Colusa (RM 143) as well as portions of Elder Creek, Deer Creek, Chico Creek, and Mud Creek. Table 2-1 provides the watercourses by region, reach lengths in miles, total length by region, and counties within the program area.

Table 2-1. Watercourses, Reach Lengths, and Counties within the Program Area by Region

Region	Watercourse	Leveed Reach Length (miles)	Total Length by Region (miles)	Counties
1a	Sacramento River from Collinsville to Isleton	20.7	172.0	Sacramento, Solano, Sutter, Yolo
	Threemile Slough	3.7		
	Georgiana Slough	12.4		
	Steamboat Slough	13.1		
	Yolo Bypass	37.9		
	Miner Slough	7.7		
	Portions of Lindsey Slough	7.5		
	Cache Slough	10.7		
	Ulatis Creek Bypass Unit	1.6		
	Haas Slough	2.8		
	Sutter Slough	6.8		
	Elk Slough	9.3		
	Putah Creek	8.9		
	Willow Slough Bypass	7.4		
	Sacramento Bypass	1.8		
	Cache Creek from the Yolo Bypass to the upstream limit of the project levees	13.3		
	Knights Landing Ridge Cut	6.4		
1b	Sacramento River from Isleton to Feather River (RM 20–80)	60.3	105.0	Placer, Sacramento, Solano, Sutter, Yolo
	American River from Sacramento River to RM 13	13.2		
	Arcade Creek	2.1		
	Dry Creek (South)	1.7		
	Pleasant Grove Canal	3.0		
	Natomas East Main Drain	14.5		
	Natomas Cross Canal	5.3		
	Coon Creek Group Interceptor Unit 6	4.9		

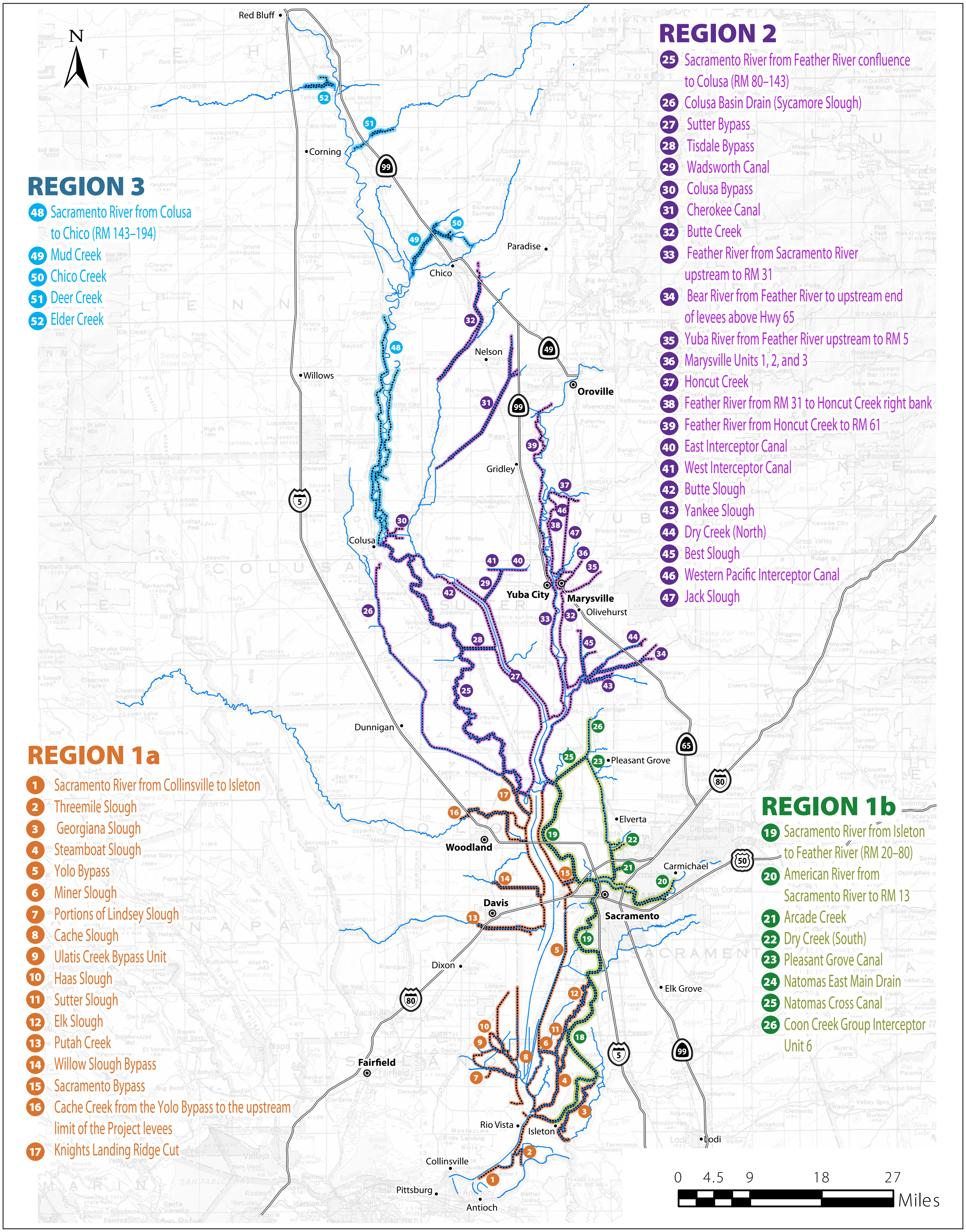


Figure 2-1
Program Regions
Sacramento River Bank Protection Project

ICF INTERNATIONAL

Region	Watercourse	Leveed Reach Length (miles)	Total Length by Region (miles)	Counties
2	Sacramento River from Feather River confluence to Colusa (RM 80–143)	62.3	317.6	Butte, Colusa, Glenn, Placer, Sutter, Yolo, Yuba
	Colusa Basin Drain (Sycamore Slough)	35.8		
	Sutter Bypass	37.2		
	Tisdale Bypass	4.3		
	Wadsworth Canal	4.6		
	Colusa Bypass	2.8		
	Cherokee Canal	20.4		
	Cottonwood Creek	0.8		
	Butte Creek	17.3		
	Feather River from Sacramento River upstream to RM 31	30.8		
	Bear River from Feather River to upstream end of levees above State Route 65	12.6		
	Yuba River from Feather River upstream to RM 5	4.9		
	Marysville Units 1, 2, and 3	7.5		
	Honcut Creek	4.7		
	Feather River from RM 31 to Honcut Creek right bank	13.2		
	Feather River from Honcut Creek to RM 61	16.2		
	East Interceptor Canal	3.7		
	West Interceptor Canal	1.8		
	Butte Slough	8.0		
	Yankee Slough	4.5		
	Dry Creek (North)	8.4		
	Best Slough	2.0		
	Western Pacific Interceptor Canal	6.2		
	Jack Slough	7.6		
3	Sacramento River from Colusa to Chico (RM 143–194)	50.3	73.3	Butte, Colusa, Glenn, Tehama
	Mud Creek	8		
	Chico Creek	4.3		
	Deer Creek	6.7		
	Elder Creek	4		

Source: Sacramento River Bank Protection Project Extent [shapefile]. SPK-USACE 2009. ArcGIS 9.3, ESRI.

Erosion Sites

The Corps' Sacramento District, the proposed program's nonfederal sponsor, the CVFPB, and the California Department of Water Resources conduct annual field reconnaissance reviews of the SFRCP. Specific criteria are used to identify erosion sites within the system as described in the Corps' Field Reconnaissance Report of Bank Erosion Sites and Site Priority Ranking (Ayres Associates 2008). In most cases the criteria are based on bank and levee conditions that are threatening the function of individual basins within the system or the flood control system as a whole. An erosion site is defined as:

> A site that is at risk of erosion during floods and/or normal flow conditions; the term *critical* is used to indicate erosion sites that are an imminent threat to the integrity of the flood control system and of the highest priority for repair.

A site is typically identified as an erosion site if the erosion has encroached into the projected levee prism (e.g., 35 feet or less of bank). A typical levee prism has a landside slope, a levee crown (top of the levee), and a waterside slope. The projected levee slope is the hypothetical extension of the landside and waterside slopes as the actual levee slopes "project" below the surrounding ground surface, forming the levee foundation. The Corps is currently in the process of updating its process for selecting erosion sites for repair. However, the programmatic analysis in this EIS/EIR is based on the representative sample of sites contained in the "Final Alternatives Report–80,000 LF" (Kleinfelder-Geomatrix 2009). The SRBPP itself relies on annual field reconnaissance reports.

The representative sites selected for the Final Alternatives Report—80,000 LF were informed by the 2008 Field Reconnaissance Report (Ayres Associates 2009), which identified 154 erosion sites. Many of these 154 erosion sites are not classified as critical, but they do pose a substantial risk of erosion and threat to the flood control system and would continue to be considered erosion sites under the new site selection process. The 107 representative sites, totaling approximately 80,000 LF, are used for evaluation and identification of suitable design alternatives for bank protection in the Final Alternatives Report–80,000 LF. Sites selected by the Corps for further evaluation and identification of suitable bank protection designs exhibited bank and levee conditions that are threatening the function of the flood control system (Kleinfelder-Geomatrix 2009). After publication, a discrepancy was found in the Final Alternatives Report regarding a site at Natomas Cross Canal 3.0 L. The site has since been removed from the evaluation list, leaving 106 sites.

For purposes of this EIS/EIR, the 106 selected eroding sites along the Sacramento River and its tributaries constitute a representative sample of the sites eventually proposed to be treated under the supplemental 80,000 LF. However, the number and extent of documented sites can change from year to year because of various factors, including newly identified sites, increased or decreased rates of erosion, repaired sites, reclassification of erosion sites to maintenance sites, and removed sites. Therefore, because streambank erosion is episodic and new erosion sites can appear each year, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety, but relying on data associated with the 106 representative sites when appropriate in order to provide the most detailed programmatic analysis possible. Additional project-level environmental documentation, tiering from this programmatic analysis, will be prepared to address those sites that will be constructed.

Proposed Site-Specific Bank Protection Measures

The suite of SRBPP site-specific bank protection measures in the proposed program is described below with figures to support each measure. A bank protection measure is a site-specific design solution to control an existing erosion site while minimizing and/or mitigating environmental impacts.

The following criteria have been developed for bank protection design, consistent with the project purpose and need.

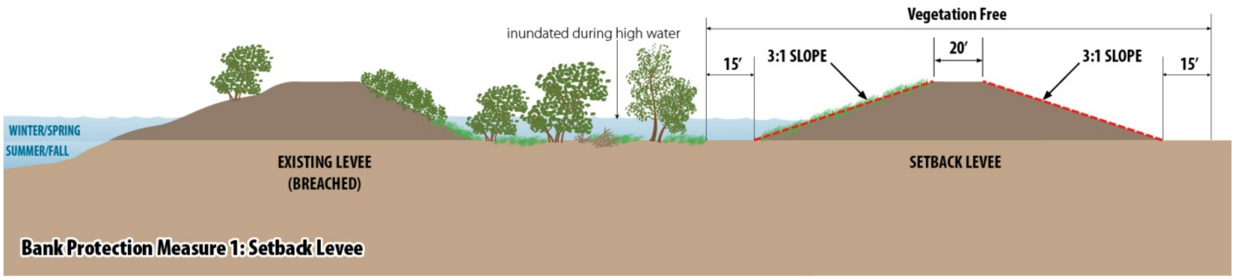
- Restoring the flood damage risk-reduction capability of the originally constructed levee through the use of structurally reliable erosion-control elements.
- To the extent practicable, maintaining fish and wildlife habitat and scenic and recreational values, and replacing habitat losses through the use of on-site mitigation elements overlying or integrated with erosion-control elements.
- Fully mitigating off-site significant residual fish and wildlife habitat losses to the extent justified.
- Minimizing costs of construction and maintaining both erosion-control and on-site habitat-mitigation elements.

The following measures are intended to meet these criteria while also meeting the Corps vegetation management policy as prescribed in Engineering Technical Letter 1110-2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures (Vegetation ETL) (U.S. Army Corps of Engineers 2014). For purposes of this EIS/EIR, the vegetation-free zone (VFZ) is defined in the Vegetation ETL and encompasses the existing and new levee footprint area 15 feet outward of each levee toe where vegetation would be restricted to native grass. These measures are conceptual and will be modified to the degree necessary to be suitable for conditions at any given erosion site. As a result, dimensions in the following figures are typical and will vary based on site-specific conditions and designs.

Bank Protection Measure 1–Setback Levee

This measure entails constructing a new levee some distance landward of the existing levee, and avoids or minimizes construction in the waterside or riparian areas. The land between the setback and existing levee would act as a floodplain. Land use in the new floodplain would be determined on a site-by-site basis. The old levee could be breached in several locations or degraded to allow high flows to inundate the new floodplain. Vegetation on the new setback levee, including 15 feet beyond each toe, would be restricted to grass. While vegetation could remain on the existing levee, the setback levee would be managed as a VFZ. New vegetation planted in the setback area could serve as mitigation to offset project losses. Additionally, vegetation on the existing levee could become newly available to aquatic species and contribute to a net increase in floodplain vegetation.

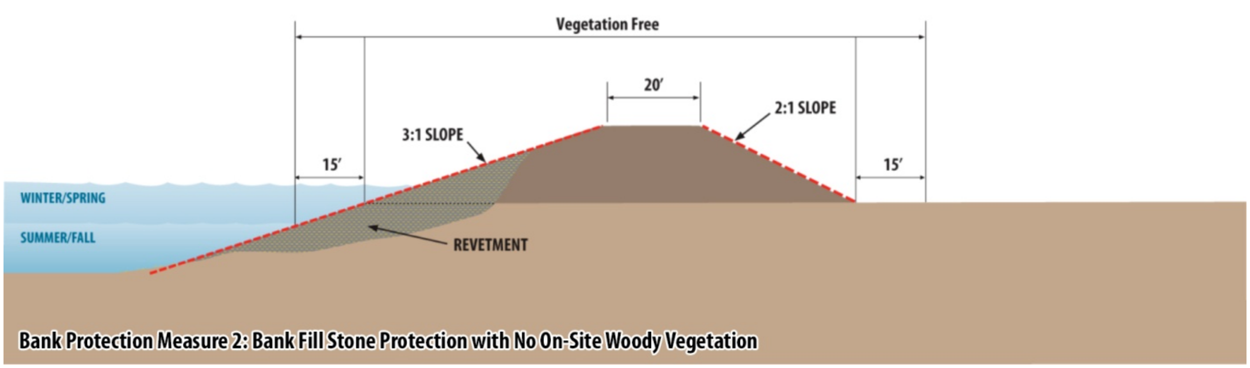
Measure 1 would be most applicable in areas where substantial habitat values exist along the channel and land uses in the setback area are not restrictive. Setback levees can be very effective, but real estate acquisition (including the need for willing sellers), existing land use, and technical issues limit opportunities for setback levees in the program area. Setback levees may offer opportunities for mitigation of riparian, bank swallow, and fish habitat loss at other bank protection sites and restore riverine processes. Setback levees may also provide other flood control benefits, such as addressing seepage issues, that other bank protection measures would not address.



Bank Protection Measure 1: Setback Levee

Bank Protection Measure 2–Bank Fill Stone Protection with No On-Site Woody Vegetation

This measure, which entails filling the eroded portion of the bank and installing quarry stone along the levee slope, is needed as determined by site-specific analysis. The rock/soil ratio will vary by location and will be determined during site-specific design. Vegetation would be limited to native grass, and existing vegetation would be removed within the VFZ. If there is a natural bank distinct from the levee that requires erosion protection, it would be treated with revetment. Measure 2 would be most applicable in areas where there is inadequate space or substantial constraints (for example, critical infrastructure, homes, roadways, pump facilities, real estate issues), either landside or waterside, where hydraulic concerns would make it difficult to implement the other measures, or where existing habitat values are very limited.

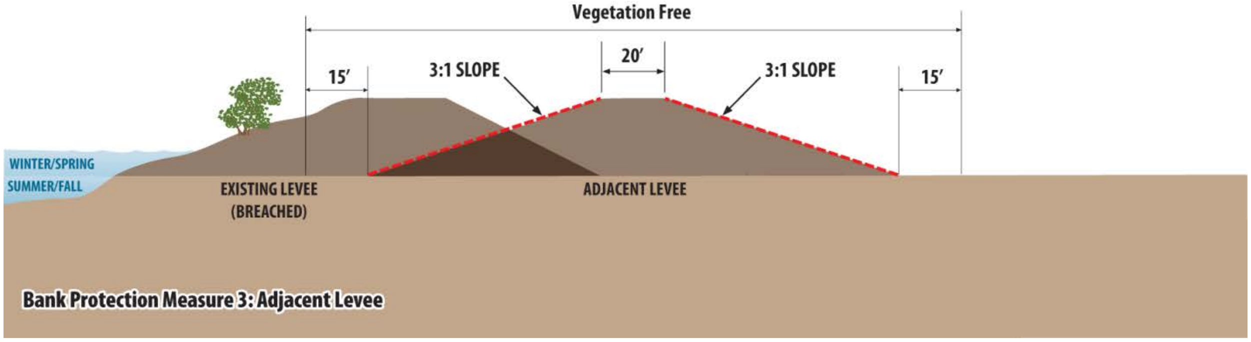


Bank Protection Measure 2: Bank Fill Stone Protection with No On-Site Woody Vegetation

Bank Protection Measure 3–Adjacent Levee

This measure involves the construction of a new levee embankment adjacent to and landward of the existing levee. The adjacent levee would be constructed to Corps design standards, which require adjacent levees to be constructed with 3:1 slopes (distance width to distance height, or dW:dH) on both the waterside and landside. The landward portion of the existing levee would be an integral, structural part of the new levee. The waterward portion of the existing levee would remain. Vegetation and instream woody material (IWM) could be placed on the old levee if that portion is outside of the VFZ. However, a variance under the Vegetation ETL may be required if the existing levee is considered to be a waterside planting berm based on its dimensions and proximity to the new levee. The existing levee may also be degraded to riparian and/or wetland benches that comply with the Corps' vegetation management policy. Vegetation on the landward side of the existing levee and within the footprint of the new adjacent levee would be removed as a part of construction.

Measure 3 would be appropriate at many sites where waterside berms are narrow or non-existent but landside uses limit the use of a setback levee.



Bank Protection Measure 4–Riparian and Wetland Benches with Revegetation

Measure 4 consists of three design variations presented as Measures 4a, 4b, and 4c. In general, Measure 4 involves the placement of clean quarry stone from the toe of the bank up to the summer/fall waterline and placing quarry stone and soil-filled quarry stone on the levee slope above the summer/fall waterline. The rock/soil ratio will vary by location and will be determined during site-specific design. The repairs would involve initial site preparation and construction of levee embankment. Measures 4a, 4b, and 4c would comply with the Vegetation ETL, requiring all woody vegetation within the VFZ to be removed.

Measures 4a, 4b, and 4c vary from one another with regard to the placement and extent of environmental features that are intended to increase habitat quality (bank construction, vegetation, and IWM). These variations are driven by a number of factors, most importantly the types of existing resources and the types of species likely to use those resources. For example, if the existing site is downstream of Sacramento River Mile 30 and likely to be used by delta smelt, the new design would not include IWM below the summer/ fall waterline, because IWM is not considered optimal habitat for delta smelt. New IWM would only be installed downstream of RM 30 to replace existing IWM removed during repair of the bank (1:1 ratio). Upstream of RM 30, new IWM is usually incorporated into the design, because delta smelt aren't likely to be present.

In general, plantings consistent with the Vegetation ETL and outside of the VFZ at each site could include box elder (*Acer negundo*), white alder (*Alnus rhombifolia*), Oregon ash (*Fraxinus latifolia*), western sycamore (*Platanus racemosa*), Fremont cottonwood (*Populus fremontii*), Valley oak (*Quercus lobata*), Goodding's willow (*Salix gooddingii*), red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis*), California wild rose (*Rosa californica*), and narrowleaf willow (*Salix exigua*).

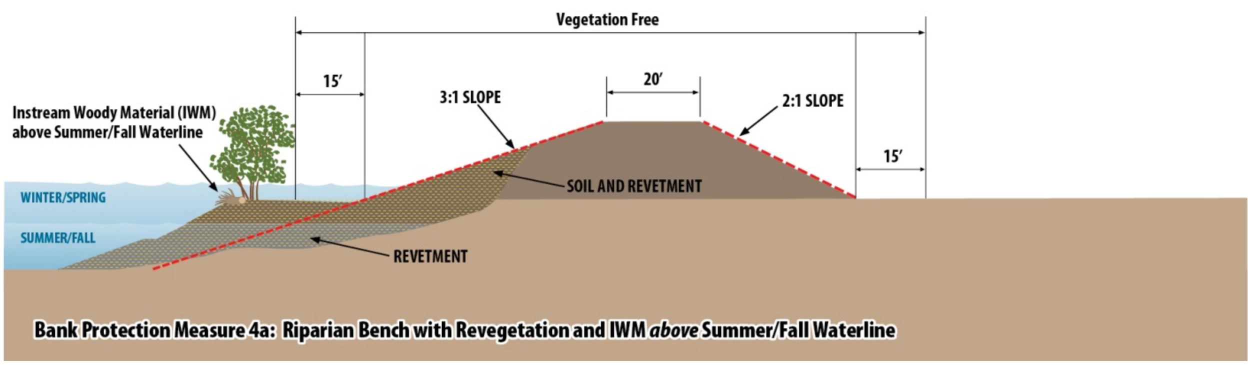
These measures are appropriate where the channel is wide enough to accommodate the installation of the stone and soil structure without substantially affecting the hydraulic capacity of the channel.

Bank Protection Measure 4a – Riparian Bench with Revegetation and Instream Woody Material above Summer/Fall Waterline

Measure 4a entails installing revetment along the waterside levee slope or bank as well as a rock/soil bench to support riparian vegetation and provide a place to anchor IWM. This design provides near-bank, shallow-water habitat and components of shaded riverine aquatic habitat for fish and is typically applicable to sites upstream of Sacramento River Mile 30. Treatment of existing vegetation, site preparation, and installation of revetment on the lower slope would be similar to the description under Measure 2. Measure 4a includes a riparian bench. The bench would be treated with soil-filled quarry stone.

In this design, the riparian bench is intended to be inundated at river stages corresponding to high tide (where tidally influenced) or during average winter/spring flows. The riparian bench would be revegetated in a manner similar to recent SRBPP projects with riparian bench designs. Species planted would be in compliance with the Vegetation ETL. Planting plans would describe species to be planted within a specific elevation zone and would detail the number, area and spacing of plants to be installed, and whether the plants are from cuttings or containers.

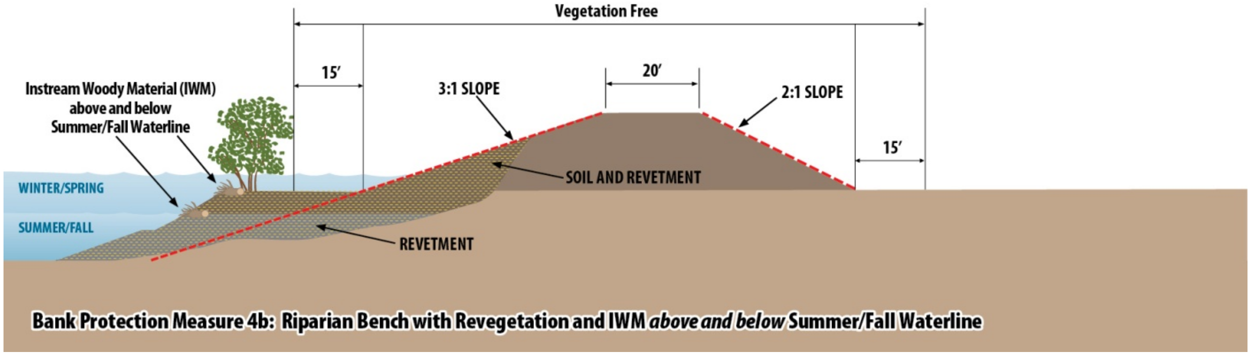
The riparian bench would be constructed at a slope of 6:1 to 10:1 and the revetment portion above and below the bench would typically be 3:1. The width of the bench would be approximately 10–30 feet, depending on site conditions. Anchored IWM would be embedded on top of the riparian bench above the summer/fall waterline. The IWM would be available as accessible habitat along the banks only during winter/spring flows when the bench is inundated. Individual pieces of IWM would be placed to fit the project site's hydraulic conditions and based on other applicable guidance. Exact shoreline coverage amounts and complexity components will be determined during site-specific design.



Bank Protection Measure 4b–Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

This measure entails installing revetment along the waterside levee slope or bank as well as a rock/soil bench (as described for Measure 4a) to support riparian vegetation and provide a place to anchor IWM. In addition to the placement of IWM above the summer/fall waterline as described for Measure 4a, IWM also would be placed beyond the bench and below the summer/fall waterline, thereby increasing the types and extent of shallow-water fish habitat, providing year-round instream habitat for targeted fish species. This design is typically applicable to sites upstream of

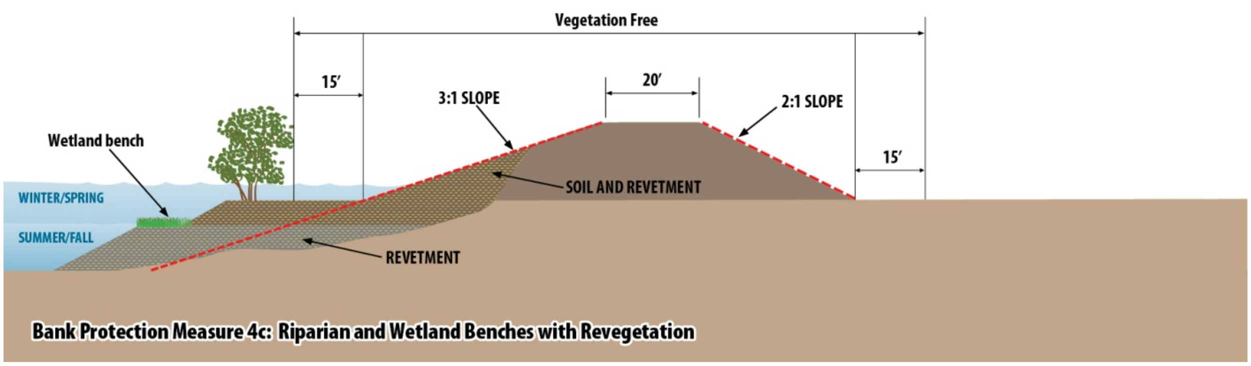
Sacramento River Mile 30. Treatment of existing vegetation, site preparation, and installation of lower slope quarry stone would be similar to Measure 2. Installation of soil-filled quarry stone and riparian bench would be similar to Measure 4a.



Bank Protection Measure 4c–Riparian and Wetland Benches with Revegetation

Measure 4c entails installing revetment along the waterside levee slope or bank, as well as a rock/soil bench to support riparian vegetation and provide a place to anchor IWM. Bench slopes would be the same as those described for Measure 4a. The design also includes a wetland bench below the summer/fall waterline to further increase habitat quality. This design is intended for sites downstream of Sacramento River Mile 30 and targets mitigation of impacts on delta smelt habitat. Because IWM might increase habitat suitability of ambush predators, new IWM would only be installed to replace existing IWM removed during project construction (1:1 ratio).

The riparian and wetland benches are intended to flood at river stages corresponding to winter/spring (high) flows and summer/fall (low) flows, respectively. Existing vegetation would be removed within VFZ. Both benches would be revegetated in compliance with the Vegetation ETL and in accordance with appropriate planting plans. The wetland bench would typically be planted with hardstem bulrush (*Scirpus acutus*), California bulrush (*S. californicus*), or giant bur-reed (*Sparganium eurycarpum* ssp. *eurycarpum*).

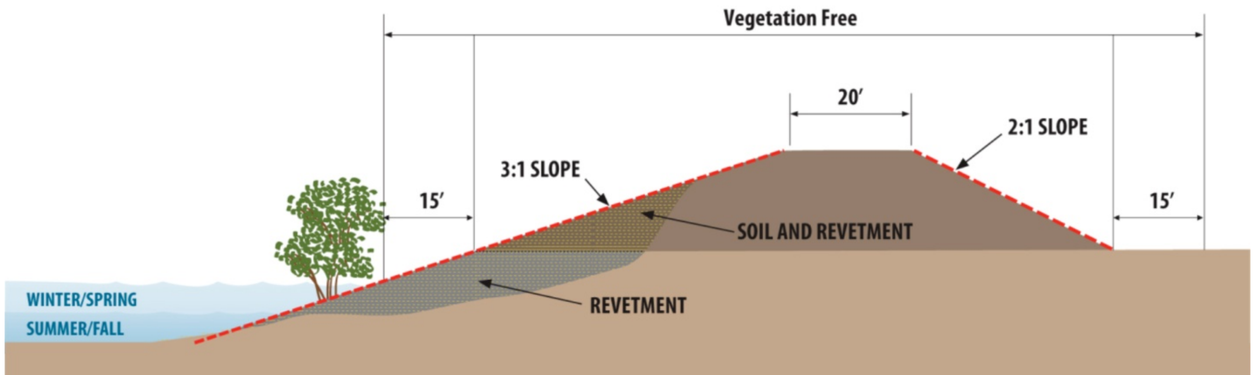


Bank Protection Measure 5–Bank Fill Stone Protection with On-Site Vegetation

Measure 5 entails filling the eroded portion of the bank and installing revetment along the waterside levee slope and streambank from streambed to a height determined by site-specific analysis. The revetment would be placed at a slope of 3:1. All IWM would be removed from the bank and would not be replaced on the bank fill stone protection.

Existing vegetation would be removed within the VFZ; however, grass would be allowed in this area. Approximately 25% of existing vegetation that is outside of the VFZ on the waterside slope is estimated to be retained during construction. This assumption is made for analysis purposes and is based on past construction experience. The actual amount of retained vegetation could vary substantially from site to site during implementation. New vegetation would be limited to native grasses within the VFZ, while woody vegetation could be replaced by planting outside of the VFZ, as allowed by specific site conditions. The long-term goal of vegetation planting is to provide riparian and shaded riverine aquatic (SRA) cover habitat as defined by the U.S. Fish and Wildlife Service. Planting plans would describe species to be planted within a specific elevation zone and would detail the number, area and spacing of plants to be installed, and whether the plants are from cuttings or containers. Six inches of soil cover would be placed on the revetment to support on-site vegetation. If there is a natural bank distinct from the levee that requires erosion protection, it would be treated with revetment.

Similar to Measure 2, Measure 5 would be most applicable in areas where there is inadequate space or substantial constraints that would limit the applicability of the other measures. However, some amount of space to allow for the planting of vegetation is necessary.



Bank Protection Measure 5: Bank Fill Stone Protection with On-Site Vegetation

Additional Measures

Additional measures may be considered and found to be appropriate during implementation of the site-specific repairs. Design and analysis of any additional measures would be carried out during the site-specific planning and design phase.

Examples of additional measures include toe protection, flow modification (e.g., impermeable groins) and alternative materials in place of riprap.

Toe Protection

Toe protection is authorized by SRBPP and could be considered for long-term erosion control. Toe protection entails filling the low-lying eroded portion of the bank with rock to curtail further loss of the toe and subsequent losses of the upper bank typically resulting from toe erosion. Because toe protection doesn't replace existing losses of material on the upper bank, which is often the condition at critical sites, it is not considered a complete solution for critical sites. Consequently, toe protection has not been implemented recently because many erosion sites are considered to be at or near critical.

Flow Modification

Groins, or spurs, redirect or reduce erosive forces along the channel bank by diverting the stronger currents and deflecting water away from the bank. By deflecting the current away from the bank and causing sediment deposits, a spur or a series of spurs may protect the streambank more effectively and at a lower cost than revetment. Long spurs or groins may also be called spur dikes, and very long spurs can be referred to as dikes and jetties. Spurs are also used to channelize a wide, poorly defined stream into a well-defined channel that neither aggrades nor degrades, thus maintaining its location from year to year. Spurs on streams with suspended sediment induce sedimentation to establish and maintain the new alignment. Dikes fall in the category of an erosion control or flow diversion structure extending roughly perpendicular from a streambank that either diverts flow from the bank or reduces flow velocity adjacent to the bank. Flow diversion also can be accomplished through biotechnical methods in some locations. For example, log brush barriers are densely packed layers of branches and logs that divert stream flow from an eroding bank.

A bendway weir is an upstream-angled underwater sill. Water flowing over the weir is redirected at an angle perpendicular to the weir. When weirs are angled upstream, water is directed away from the outer bank and toward the inner part of the bend, breaking up the river's strong secondary currents. Weirs are typically built in sets (4 to 14 weirs per bend) and are designed to redirect current directions and velocities through the bend and well into the downstream crossing.

Alternative Materials and Construction Methods

Reinforced Soil Slopes and Mechanically Stabilized Earth Walls

Mechanically stabilized earth walls (MSEWs) are internally reinforced soil structures with faces angled 70 degrees to 90 degrees from horizontal. Structures with slope angles less than 70 degrees are termed reinforced soil slopes (RSSs).

MSEWs and RSSs use soil and rock with structural elements, such as geogrids, to provide for steeper stable slopes than typically occur naturally. These structures provide long-term stability yet can be porous enough to provide filtration and support vegetated growth. Vegetated MSEW and RSS structures can become stronger as root systems penetrate and grow throughout the retained mass, providing a long-term vegetated solution for erosion and soil retention issues. The engineered MSEWs and RSSs remain to provide stability during the time it takes vegetation to become established, as well as into the long term. The advantage of these structures is a more natural appearance in areas with limited rights-of-way or unacceptable encroachment within the channel compared with some other repair methods.

Artificial Floating Structures

Artificial floating structures are modeled after natural floating islands formed when floating vegetation grows and accumulates gas, or nutrient rich peat soil becomes buoyant, rises to the surface, and is colonized by plants. Artificial floating structures are made of a recycled nontoxic plastic mesh injected with marine foam for initial buoyancy. Artificial floating structures can be used to enhance fish habitat by simulating submerged, vegetated undercut banks and providing overhead shaded cover. The resulting underwater root structure may provide important habitat, including forage, refuge from predators, spawning substrate, and brood cover for many fish species. However, the potential for increased predation associated with artificial floating structures is not well understood. Artificial floating structures might be useful in absorbing wave and wake energy, modifying flows and hydraulic processes, complementing shoreline restoration, and providing shallow water habitat. Artificial floating structures might be useful and practical in the Delta along river banks where the current is not strong.

Alternatives Development

NEPA and CEQA generally require that an EIS and EIR consider all reasonable alternatives that would attain the project purpose, need, and objectives while avoiding or substantially lessening project effects. A range of reasonable alternatives is analyzed to define the issues and provide a clear basis for choice among the options (40 Code of Federal Regulations (CFR) Section 1502.14). The NEPA and CEQA analysis also must analyze a no action, or no project, alternative.

The Council on Environmental Quality regulations for implementing NEPA require all reasonable alternatives to be objectively evaluated in an EIS (40 CFR Section 1502.14(a)). Alternatives that cannot reasonably meet the project purpose and objectives can be eliminated from further review (CEQ Guidelines 1502.13); however, the environmental document must explain the reason(s) for dismissal (CEQ Guidelines 1502.14(a)). An EIS must also study, develop, and briefly describe appropriate alternatives to the proposed action where there exist unresolved resource conflicts (42 United States Code [USC] Section 4332[2][E]). NEPA does not require alternatives to offer some environmental benefit over the proposed action, neither does it discourage consideration of alternatives with lesser effects. NEPA requires that reasonable alternatives be evaluated in the same level of detail (40 CFR Section 1502.14[b]).

Similarly, CEQA requires that the lead agency consider alternatives that would avoid or reduce one or more of the significant impacts identified for the project in an EIR. The State CEQA Guidelines state that the range of alternatives required to be evaluated in an EIR is governed by the “rule of reason;” the EIR needs to describe and evaluate only those alternatives necessary to permit a reasoned choice and to foster informed decision making and informed public participation (Section 15126.6[f]). Consideration of alternatives focuses on those that can either eliminate significant adverse environmental impacts or reduce them to less-than-significant levels; alternatives considered in this context may include those that are more costly and those that could impede to some degree the attainment of all the project objectives (Section 15126.6[b]). CEQA does not require the alternatives to be evaluated in the same level of detail as the proposed project.

Consistent with NEPA standards, alternatives at the program level are analyzed at an equal level of detail. As required under NEPA and CEQA, a no action (no project) alternative has been included in this document to allow the Lead Agencies to compare the effects of the proposed alternatives with the effects of taking no action.

The alternatives were developed using those bank protection measures considered to reasonably meet the project's purpose, need, and objectives. Alternatives development also took into consideration an alternative's ability to eliminate significant adverse environmental impacts or reduce them to less-than-significant levels, as well as minimize any contribution to cumulative effects.

In addition to the no action alternative, five action alternatives, as well as a sub-alternative of each action alternative, are analyzed. The five action alternatives apply a site-specific bank protection measure (design solution) to each of the 106 sites. In general, selection of bank protection measures at specific sites is based on consideration of the likely causes of erosion, local conditions that could impact repair and construction, and site-specific considerations for vegetation, wildlife, land ownership, and access. The site-specific bank protection measure applied to each site may vary from one action alternative to another. For example, a setback levee may be applied to an erosion site under one alternative, while a bench design may be applied to that same site under a different alternative. These variations allow for meeting the objectives of each alternative (e.g., minimizing impacts).

For bank protection measures to be feasible, they must comply with the Vegetation ETL (U.S. Army Corps of Engineers 2009). The key aspect of the Vegetation ETL that is relevant to the development of feasible alternatives is its requirement for a VFZ surrounding all levees and appurtenant structures. The VFZ must be free of obstructions to ensure access by personnel and equipment for surveillance, inspection, maintenance, monitoring, and flood-fighting. A secondary purpose is to provide a distance between root systems and levees to moderate reliability risks associated with (1) piping and seepage, and (2) structural damage (e.g., wind-driven tree overturning). However, the Vegetation ETL does provide for the use of a variance which, when justified, allows for some vegetation to remain within the VFZ. Alternative 6 includes variations of the previously described bank protection measures in that there is sometimes vegetation within the VFZ. As a result, Alternative 6A and Sub-Alternative 6B would rely on a Vegetation ETL variance.

All of the alternatives described below could be implemented in a variety of ways. Examples of potential implementation strategy variables are listed below:

- Annual construction rate.
- Annual geographic distribution (e.g., sites distributed among more than one region, all sites within one region/basin).
- Use of off-site/out-of-kind mitigation that contributes to listed species recovery.

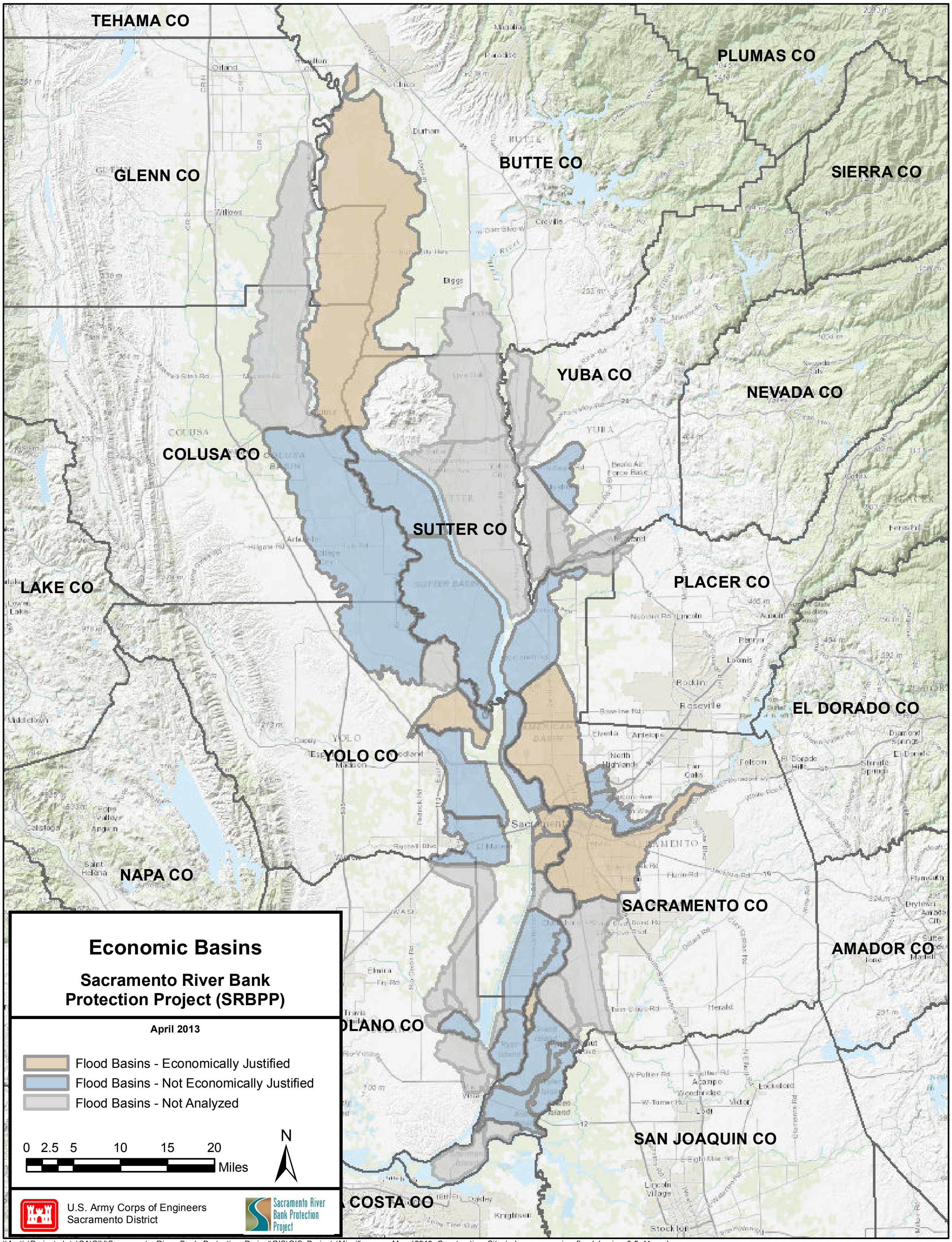
Additionally, implementation may be influenced by a benefit-cost analysis. In accordance with Corps policy, all water resources projects must have a federal interest and be justified by showing beneficial outputs greater than costs. While the traditional approach has been to look at the erosion sites in the aggregate (i.e., all 106 sites together), and that approach will likely continue, economic flood damages within individual basins or reclamation districts, maintenance areas, or levee districts would be a priority consideration in site selection.

A preliminary analysis indicates that flood damage reduction in certain less-developed regions in the program area that are primarily agricultural with fewer damageable structures is not likely to meet the benefit-cost criteria. During the implementation phase, it may be difficult to justify bank protection for levees that protect these regions. As a result, bank protection may only be considered economically justified in some portions of the program area. In other areas less developed, risk to life safety can be managed through other means such as the Public Law 84-99 Rehabilitation and Inspection Program, which allows the Corps to undertake activities including advance measures, emergency operations, and rehabilitation of flood control works threatened or destroyed by floods. Accordingly, this EIS/EIR considers a set of sub-alternatives within these “economically justified basins.” A subset of the 106 sites is analyzed under each action alternative. The subset, or sub-alternative, represents the erosion sites within seven basins that are most likely to satisfy the more restrictive approach to the benefit-cost analysis (Figure 2-2).

Following is a general description of the six alternatives: the no action alternative, and five action alternatives and their sub-alternatives (i.e., within economically justified basins). As described in Chapter 3, Guide to Effects Analysis, the effects associated with the no action alternative and the action alternatives are discussed by resource in Chapters 4 through 20. Effects associated with the sub-alternatives are discussed in Chapter 21, Effects of Implementation in Economically Justified Basins Only.

It is important to note that these alternatives are programmatic in nature and have been developed for analysis purposes. A design selection process for individual sites will be carried out prior to implementation, including additional project-specific environmental review as may be appropriate, tiering from this programmatic analysis. The process described below will be followed prior to selecting final bank protection measures for specific erosion sites.

1. **Reconnaissance/Erosion Inventory.** During the reconnaissance trip, a team reviews the existing erosion sites, identifies new sites, and checks the previously repaired sites.
2. **Critical Site Decision.** This decision step of the site selection procedure allows for a fast-track path for critical sites.
3. **Engineering Ranking and Report.** The third step of the site selection process involves development of a report and an engineering site ranking based on the information collected during the erosion reconnaissance inventory.
4. **Identify Opportunities and Constraints.** During this step of the process, all the potential issues and opportunities associated with each site are identified. This step addresses life safety, real estate, environmental, constructability, cultural resources issues, and grouping of sites. Opportunities and constraints are presented and discussed with the Inter-Agency Working Group. This step identifies sites where a Vegetation ETL variance would be applicable and is when the first steps of the variance request process would be initiated.
5. **Conceptual Level Alternatives.** Under this step the Project Delivery Team (PDT) develops conceptual-level designs and costs.
6. **Site Lock-in Procedure.** During step 6, sites are selected for inclusion on the “lock-in” list for site repairs. The sites on the “lock-in” list are generally anticipated to be repaired over the 3-year period that makes up each construction cycle.
7. **Site Selection Lock-in List and Report.** For step 7, the top sites chosen in step 6 and the fast-tracked critical sites are considered the locked-in sites selected for repair in each construction cycle. A report is written to document how and why the “locked-in” sites were selected for repair.



\\Arctic\Project_data\CA\CIV\Sacramento_River_Bank_Protection_Project\GIS\GIS_Projects\Miscillaneous_Maps\2013_Construction_Sites\srbpp_economics_flood_basins_8-5x11.mxd

Source: USACE 2013.

Graphics/Projects/06207.08 Sac Bank/EIS/EIR (06-13) SS

ICF INTERNATIONAL

Figure 2-2
Location of Economically Justified Basins

8. **Data Collection.** For this step, the PDT collects the data needed to develop the repair designs. The exact information and the level of detail collected at each site varies from site to site.

9. **Preliminary Designs and Draft NEPA/CEQA Document.** Step 9 begins the design process and the NEPA/CEQA document (draft EA/IS or draft supplemental EIS/EIR). The design alternatives are selected and 30% designs (plans, specifications, and Design Document Report [DDR]) and cost estimates are completed.

10. **Draft Final Design, Final NEPA/CEQA Document, and Pre-Construction Activities.** After an internal review of the plans, the 90% plans and specifications are developed, and the final NEPA/CEQA document is completed.

11. **Review and Final Design.** The official Agency Technical Review (ATR) and Independent External Peer Review (Type II IEPR, Safety Assurance Review) is performed throughout the development of the Plans and Specifications and the DDR. Revisions to the designs and contract documents are made based on these reviews, resulting in the 100% DDR and Plans and Specifications for Contract advertisement.

12. **Contracting Procedure.** The Corps compiles the final plans and specifications, provides the signed Biddability, Constructability, Operability and Environmental Review, and processes the funding element for construction.

13. **Construction.** Following issuance of the Notice to Proceed, the contractor constructs the bank repair.

14. **Mitigation Monitoring.** On-site mitigation requires monitoring to ensure the establishment criteria is met for vegetation growth and survival. The monitoring period must be sufficient to demonstrate that the compensatory mitigation has met performance standards, but not less than 5 years (see 33 CFR Section 332.6(b)). Monitoring reports are required on a yearly basis.

15. **Site Turn-over.** Once the construction and mitigation monitoring is complete, the Corps turns the site over to the CVFPB, which then turns the site over to the local maintaining agency.

For more detail on the Corps' site selection process, please refer to the Sacramento River Bank Protection Project, Site Selection Process for Bank Repairs (U.S. Army Corps of Engineers 2011).

Alternative 1–No Action

Under the No Action Alternative, regular operation and maintenance (O&M) of the levee system would continue as presently executed by the local maintaining entities in accordance with the existing governing O&M manual, but the Corps would not implement bank protection along SRFCP levees. The result is likely to be the continued gradual or sporadic loss of remnant floodplain (berm) and the riparian vegetation it supports, and ultimately the erosion could encroach into the cross section of the levee foundation, creating critical erosion sites. It is possible that federal or state flood control agencies or local maintaining agencies eventually would implement bank protection at various sites along SRFCP levees through emergency action. In any case, the risk of levee failure and possibly catastrophic flooding would increase substantially as more erosion sites become critical and repair is limited to emergency response. Continued erosion prior to the federal or state action would result in short- and long-term losses of valuable habitat. Although some erosion is natural, the channelization of project reaches increases erosive forces.

Alternative 2A–Low Maintenance

Alternative 2A applies Bank Protection Measure 2: Bank Fill Stone Protection with No On-Site Woody Vegetation to all 106 sites. This alternative utilizes the simplest engineering design and would rely almost exclusively on off-site mitigation. Off-site mitigation could consist of a variety of methods to increase the extent of particular habitat features in selected offsite locations, including building setback levees, construction of wetland benches or less steeply sloping banks, planting riparian trees, installation of instream wood, and removal of existing rock in locations that are deemed acceptable.

Sub-Alternative 2B–Low Maintenance within Economically Justified Basins

Sub-Alternative 2B applies Bank Protection Measure 2: Bank Fill Stone Protection with No On-Site Woody Vegetation to 18 sites within the seven economically justified basins.

Alternative 3A–Minimize Habitat Impacts

Alternative 3A applies Bank Protection Measure 1: Setback Levee or Bank Protection Measure 3: Adjacent Levee to 101 of the 106 sites. This alternative minimizes instream construction and would rely heavily on on-site mitigation, potentially creating habitat values that are in excess of what is needed at a given site. These extra habitat values could be used to offset habitat deficits at other SRBPP sites in current or future construction cycles. The Setback Levee measure is applied unless there are substantial constraints that limit the effectiveness or feasibility of that measure, in which case the Adjacent Levee measure is applied. Examples of limited effectiveness or feasibility include floodplain elevations or soil conditions that are not suitable for habitat restoration, hydraulic constraints (e.g., would adversely affect flow splits), the presence of substantial existing development, such as residential neighborhoods or utility infrastructure that would not meet its intended purpose in an alternative location, or the presence of unwilling sellers. The Adjacent Levee measure would be applied in these situations. While an adjacent levee would not create floodplain habitat, it can conserve important waterside habitat such as shaded riverine aquatic habitat and bank swallow nesting habitat.

Sub-Alternative 3B–Minimize Habitat Impacts within Economically Justified Basins

Sub-Alternative 3B applies Bank Protection Measure 1: Setback Levee or Bank Protection Measure 3: Adjacent Levee to 18 sites within the seven economically justified basins.

Alternative 4A–Habitat Replacement

Alternative 4A applies a combination of site-specific bank protection measures (Bank Protection Measures 1–5), and utilizes the bank protection measures recommended in the Final Alternatives Report to the extent that they comply with the Vegetation ETL (Kleinfelder-Geomatrix 2009). Some sites would not be compliant with the Vegetation ETL if the bank protection measures recommended in the Final Alternatives Report were applied. These particular sites were reevaluated and compliant bank protection measures were then applied. Factors taken into account in application of bank protection measures to non-compliant sites included general planning and engineering issues as well as habitat, hydraulic, and land use considerations. Off-site mitigation may be acceptable on a site-specific basis provided that it compensates for the values being lost, and mitigation is provided within the region of impact (i.e., 1a, 1b, 2, or 3).

This alternative utilizes the approach taken over the last decade, which primarily focused on re-creation of streambank habitats beneficial to target fish species through the use of constructed benches with riparian vegetation. Alternative 4A makes adjustments to the bench designs to account for implementation of the Vegetation ETL. The adjustments include: 1) changes to the areas being planted in order to avoid the VFZ; 2) the use of adjacent levees to avoid or minimize impacts on vegetation by shifting the area subject to the Vegetation ETL landward, thereby allowing more riparian vegetation to remain along the channel; and, 3) the use of setback levees, which also avoid vegetation impacts in addition to creating floodplain areas that may serve as on-site or off-site mitigation for SRBPP impacts. All of these adjustments are intended to avoid, minimize, or mitigate for impacts on various natural resources.

Sub-Alternative 4B–Habitat Replacement within Economically Justified Basins

Sub-Alternative 4B applies a combination of site-specific bank protection measures to 18 sites within the seven economically justified basins.

Alternative 5A–Habitat Replacement Reaching Environmental Neutrality

The goal of Alternative 5 is to reach "environmental neutrality" with regard to existing habitat, with an emphasis on vegetation that is beneficial to target fish species, while at the same time protecting the bank from erosion. In this case, "environmental neutrality" refers specifically to fish habitat as evaluated using the Standard Assessment Methodology (SAM) (as described in Chapter 11, Fisheries and Aquatics) and riparian habitat. The proposed program will be considered to meet environmental neutrality if the SAM values for the alternative are zero or greater (positive) and the amount of vegetation removed can be adequately replaced on-site or within other program sites within the same region (i.e., Regions 1a, 1b, 2, or 3).

Alternative 5A is similar to Alternative 4 in that it relies on the Final Alternatives Report's recommended bank protection measures and modifies those that were not Vegetation ETL compliant. Alternative 5 differs in that it minimizes the use of off-site mitigation through the application of fewer site-specific bank protection measures that result in adverse habitat effects. Alternative 5 builds on the analysis of Alternative 4 and replaces certain site-specific bank protection measures that result in substantial environmental deficits, as calculated by the Corps' Standard Assessment Methodology (SAM), or substantial losses of riparian vegetation. Environmental neutrality is defined as at least full replacement of estimated SAM and riparian vegetation losses. While mitigation outside of SRBPP sites is not anticipated under this alternative, it is considered acceptable if ultimately needed and would be provided within the region of impact i.e., Region 1a, 1b, 2, or 3).

Sub-Alternative 5B–Habitat Replacement Reaching Environmental Neutrality within Economically Justified Basins

Sub-Alternative 5B applies a combination of site-specific bank protection measures to 18 sites within the seven economically justified basins.

Alternative 6A–Habitat Replacement with Vegetation ETL Variance

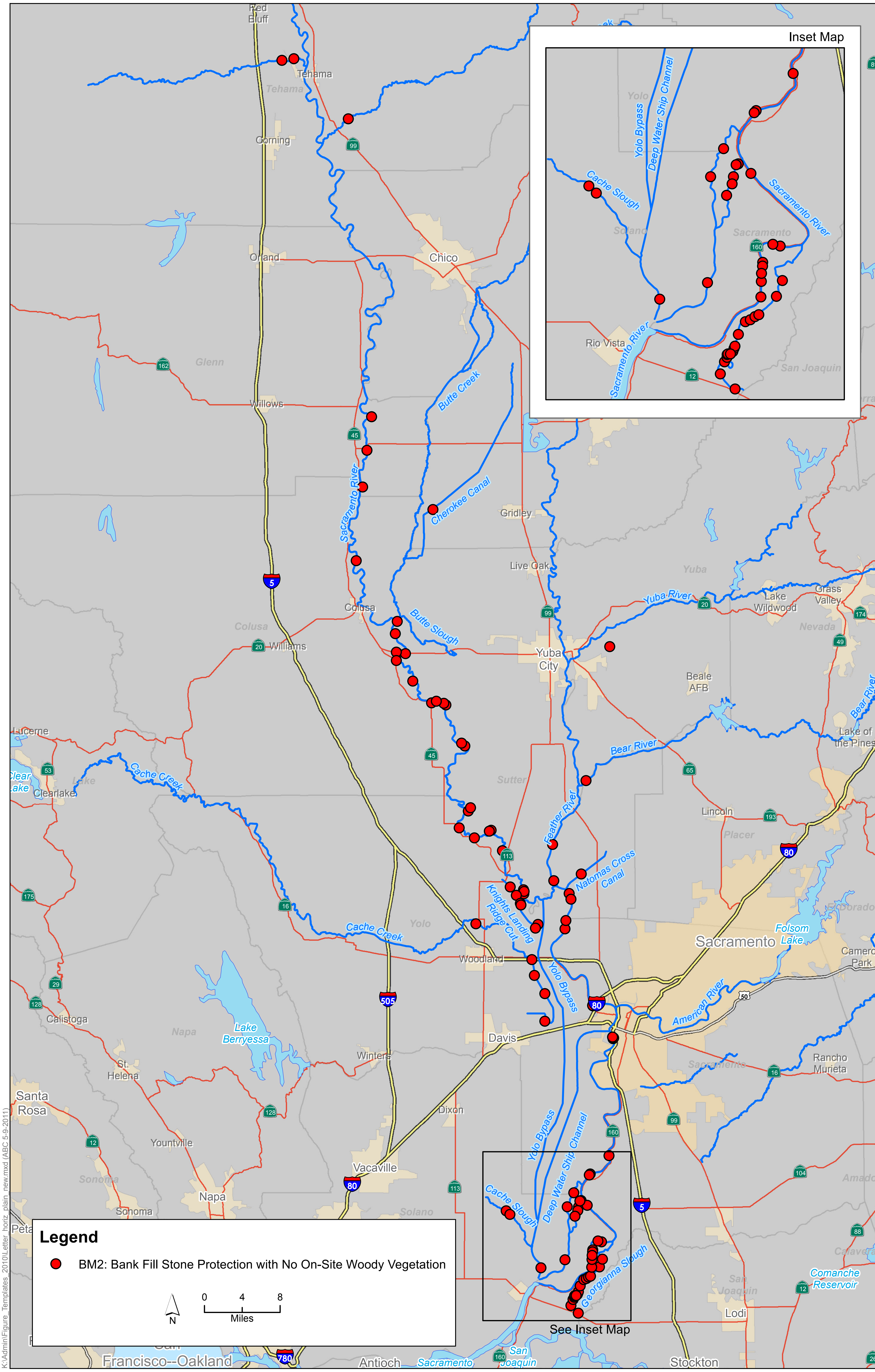
Alternative 6A applies the bank protection measures from the Final Alternatives Report without modification (Bank Protection Measures 1, 4a, 4b, 4c, and 5). While setback levees are included in the Final Alternatives Report, they were applied to very few sites as a result of the design selection process utilized in that effort, which required identification of a willing seller prior to a site being considered for a setback levee. As a result, very few setback levees are included in this alternative. A number of the bank protection measures utilized include protection of existing vegetation and placement of on-site mitigation vegetation within the VFZ and would require a Vegetation ETL variance. The area where vegetation would be preserved under a variance is typically that which is on the lower two-thirds of the waterside levee slope and the area within 15 feet of the waterside levee toe. The portion of vegetation within this area that does not need to be removed for construction purposes would be retained. Additionally, this area could be planted as a part of project construction if there are portions without vegetation. Off-site mitigation is acceptable and would be provided within the region of impact (i.e., Region 1a, 1b, 2, or 3).

Sub-Alternative 6B – Habitat Replacement with Vegetation ETL Variance within Economically Justified Basins

Sub-Alternative 6B applies the bank protection measures from the Final Alternatives Report without modification to 18 sites within the seven economically justified basins. A number of these bank protection measures include protection of existing vegetation and placement of on-site mitigation vegetation within the VFZ and would require a Vegetation ETL variance. Off-site mitigation is acceptable and would be provided within the region of impact (i.e., Region 1a, 1b, 2, or 3).

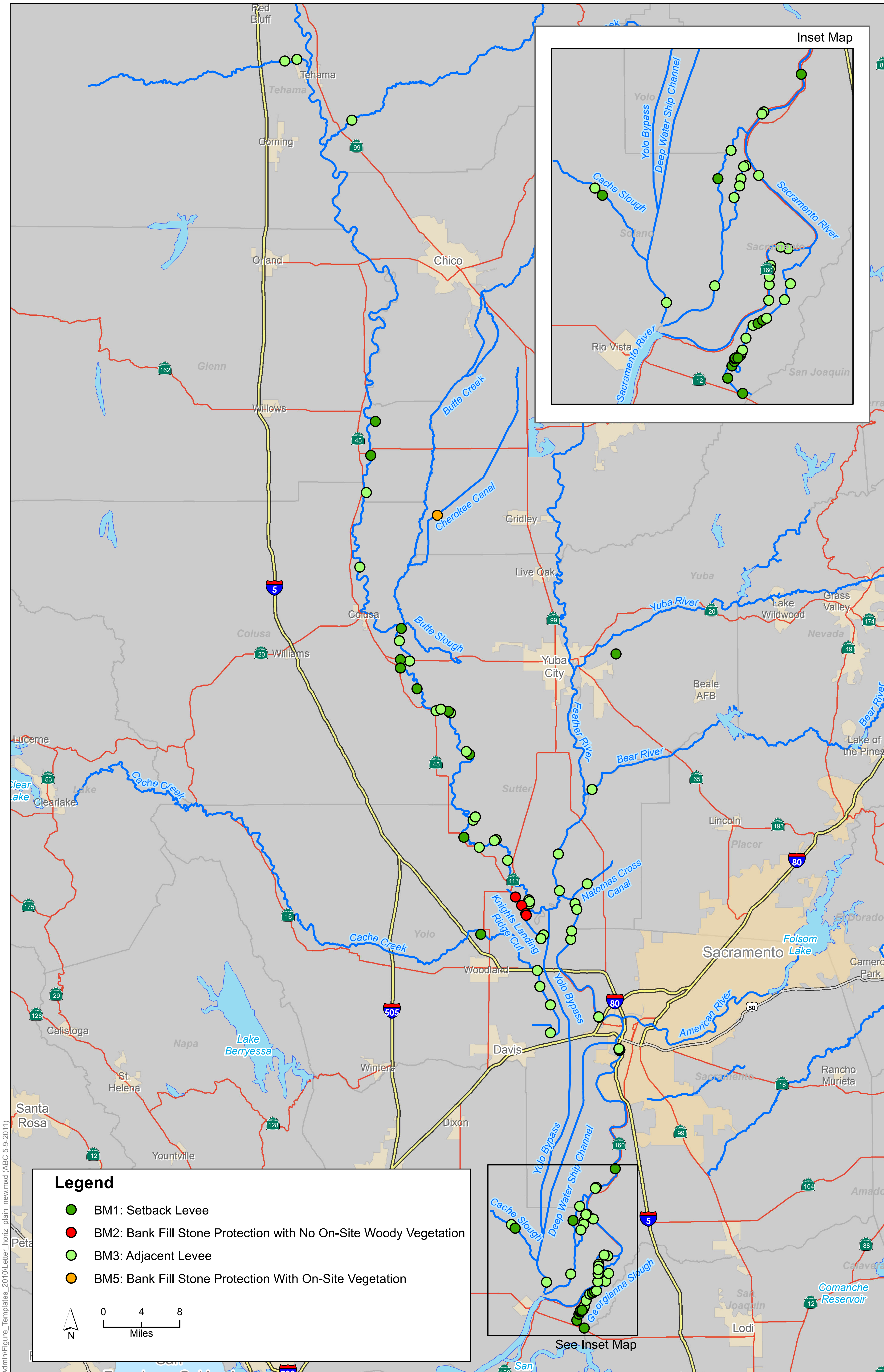
Site-Specific Bank Protection Measures by Alternative

Table 2-2 identifies the specific bank protection measures assigned to each of the 106 sites for each alternative, and includes a notation for the subset of erosion sites that are within the economically justified basins. Figures 2-3 through 2-7 show the distribution of the specific bank protection measures for each of the action alternatives.



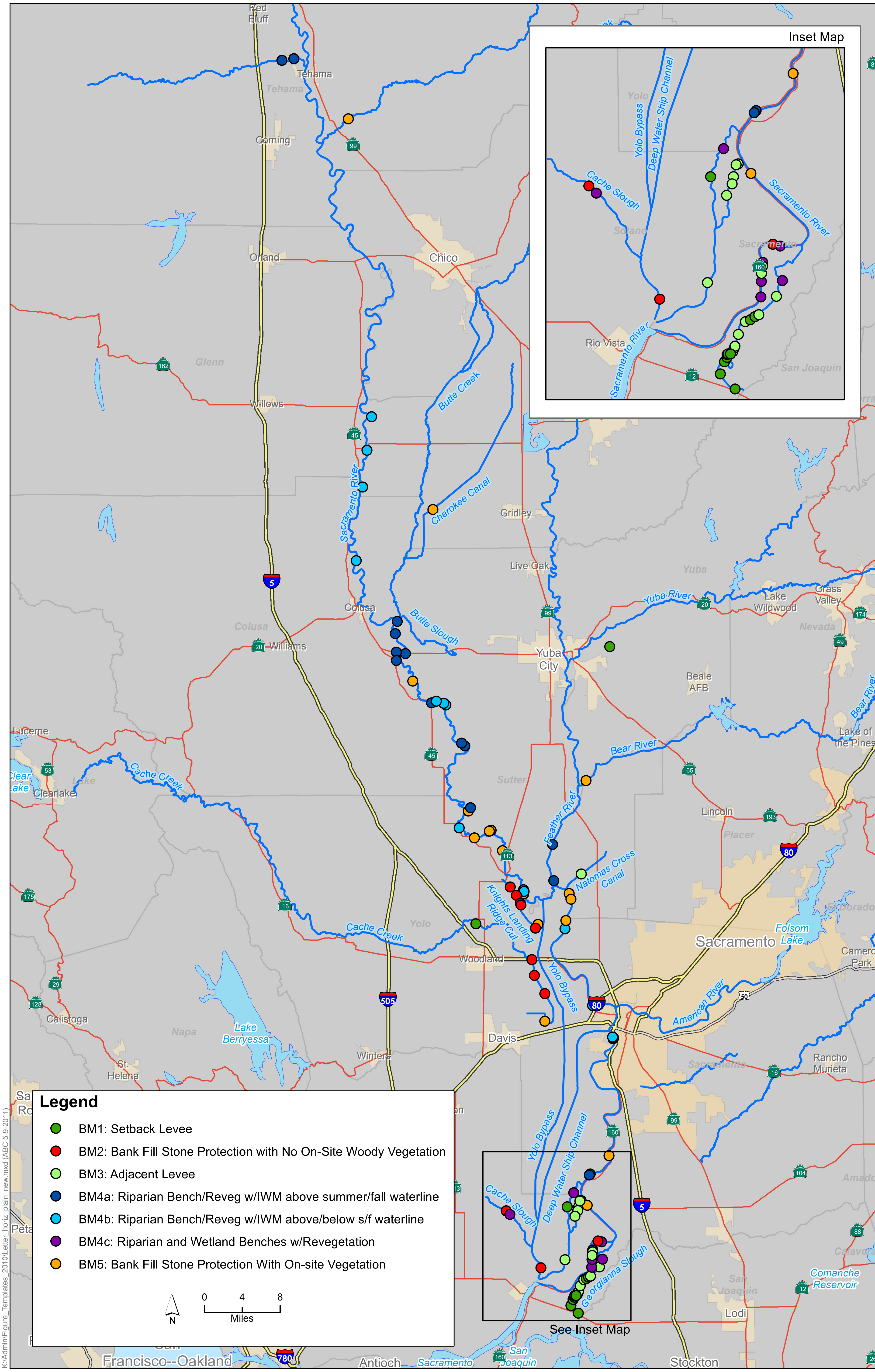
ICF INTERNATIONAL

Figure 2-3
Site-Specific Application of Bank Protection Measures for Alternative 2



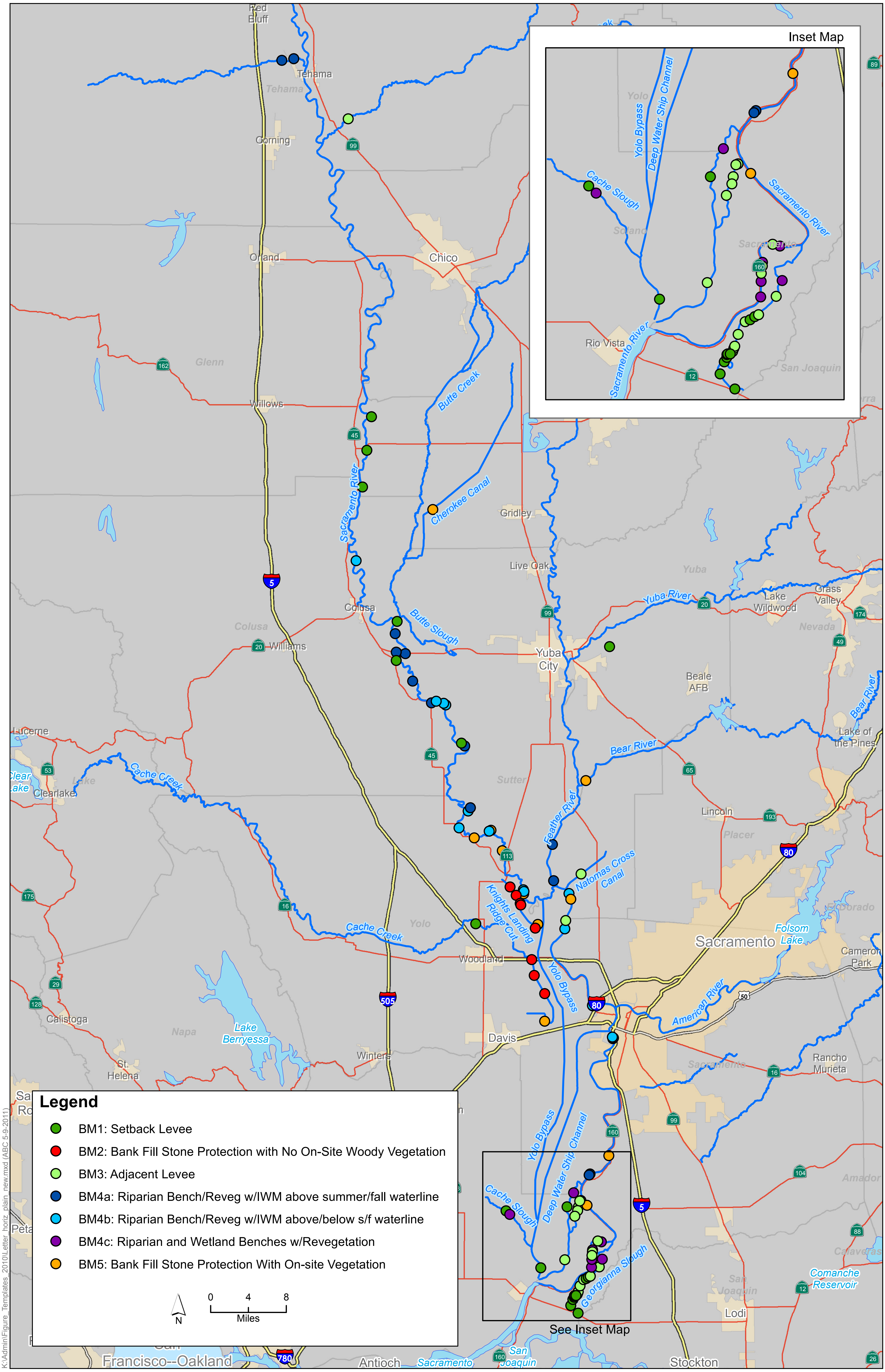
ICF INTERNATIONAL

Figure 2-4
Site-Specific Application of Bank Protection Measures for Alternative 3



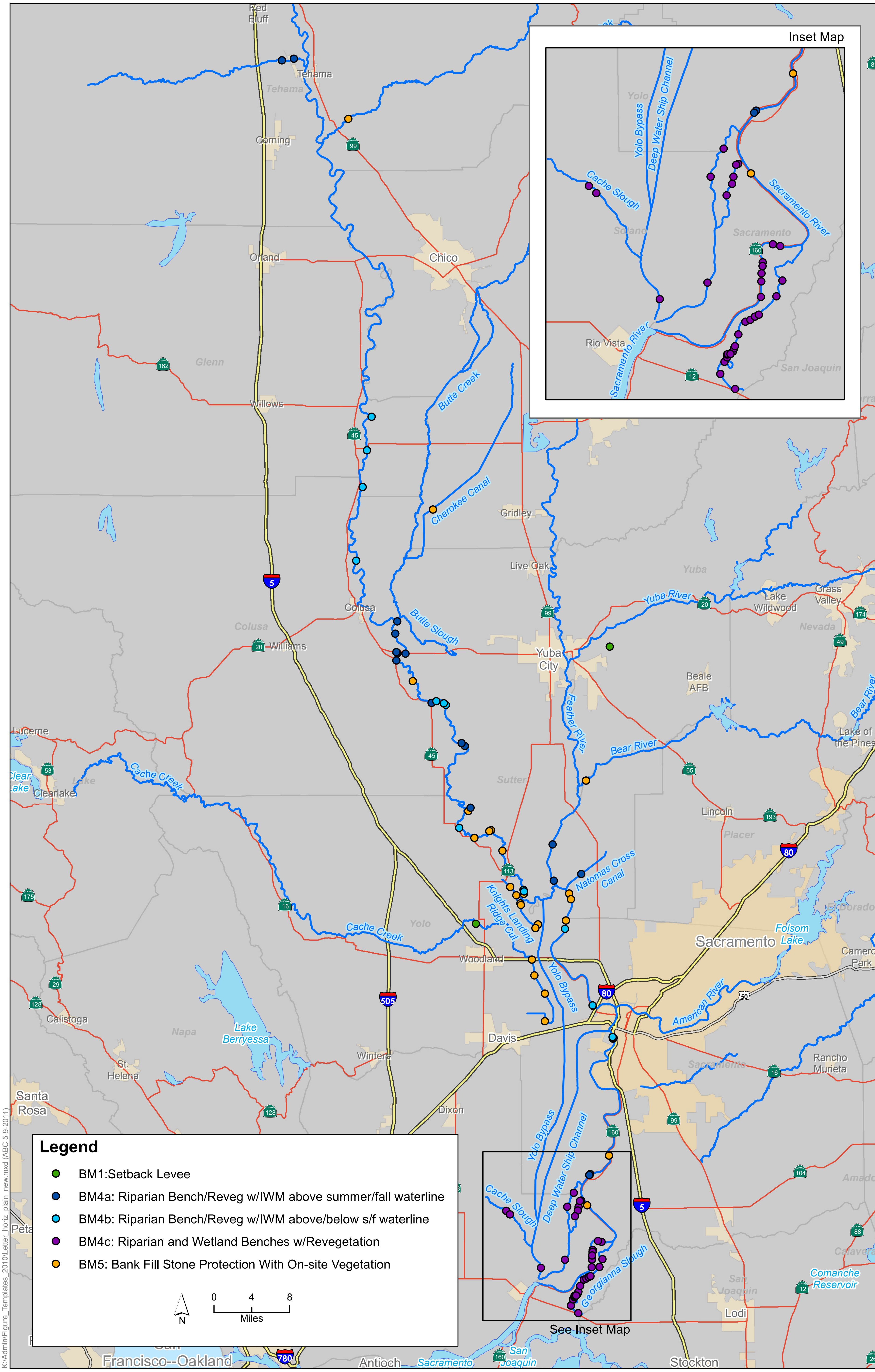
ICF INTERNATIONAL

Figure 2-5
Site-Specific Application of Bank Protection Measures for Alternative 4



K:\Admin\Figure_Templates_2010\Letter_horiz_plain_new.mxd (ABC 5-9-2011)

Figure 2-6
Site-Specific Application of Bank Protection Measures for Alternative 5



K:\Admin\Figure_Templates_2010\Letter_horiz_plain_new.mxd (ABC 5-9-2011)

Figure 2-7
Site-Specific Application of Bank Protection Measures for Alternative 6

Table 2-2. Site-Specific Application of Bank Protection Measures by Alternative

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1a+	Cache Creek	LM	3.9	L	433	2	2	1	1	1	1	1	1	1	1
1a	Cache Slough	RM	15.9	L	182	2		3		2		1		4c	
1a	Cache Slough	RM	22.8	R	630	2		1		4c		4c		4c	
1a	Cache Slough	RM	23.6	R	1,209	2		3		2		1		4c	
1a	Deep Water Ship Channel	LM	5.0	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Deep Water Ship Channel	LM	5.01	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Georgiana Slough	RM	0.3	L	1,027	2		1		1*		1		4c	
1a	Georgiana Slough	RM	1.7	L	1,250	2		1		1*		1		4c	
1a	Georgiana Slough	RM	2.5	L	736	2		1		1*		1		4c	
1a	Georgiana Slough	RM	3.6	L	1,364	2		1		1*		1		4c	
1a	Georgiana Slough	RM	3.7a	L	209	2		1		1*		1		4c	
1a	Georgiana Slough	RM	3.7b	L	268	2		1		1*		1		4c	
1a	Georgiana Slough	RM	4.0	L	705	2		1		1*		1		4c	
1a	Georgiana Slough	RM	4.3	L	1,319	2		3		3*		3		4c	
1a	Georgiana Slough	RM	4.5	L	90	2		3		3*		3		4c	
1a	Georgiana Slough	RM	4.6	L	1,346	2		3		3*		3		4c	

Bank Protection Measure Legend
N/A: No Action
1: Setback Levee
2: Bank Fill Stone Protection with No On-Site Woody Vegetation
3: Adjacent Levee
4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline
4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline
4c: Riparian and Wetland Benches with Revegetation
5: Bank Fill Stone Protection with On-Site Vegetation

Table 2-2. Continued

						Bank Protection Measures by Alternative									
Region	Site Identification				Site Length (feet)	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1a	Georgiana Slough	RM	5.3	L	3,171	2		3		3*		3		4c	
1a	Georgiana Slough	RM	6.1	L	1,729	2		3		3		3		4c	
1a	Georgiana Slough	RM	6.4	L	398	2		1		1*		1		4c	
1a	Georgiana Slough	RM	6.6	L	744	2		1		1*		1		4c	
1a	Georgiana Slough	RM	6.8	L	1,335	2		1		3		3		4c	
1a	Georgiana Slough	RM	8.3	L	483	2		3		3		3		4c	
1a	Georgiana Slough	RM	9.3	L	1,228	2		3		4c		4c		4c	
1a+	Knights Landing Ridge Cut	LM	0.2	R	768	2	2	3	3	2	2	2	2	5	5
1a	Knights Landing Ridge Cut	LM	3.0	L	1,279	2		2		2		2		5	
1a	Knights Landing Ridge Cut	LM	3.1	L	368	2		2		2		2		5	
1a	Knights Landing Ridge Cut	LM	4.3	L	577	2		2		2		2		5	
1a	Knights Landing Ridge Cut	LM	5.3	L	8,564	2		2		2		2		5	
1a	Steamboat Slough	RM	18.8	R	485	2		3		3		3		4c	
1a	Steamboat Slough	RM	23.2	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a+	Steamboat Slough	RM	23.9	R	369	2	2	3	3	3	3	3	3	4c	4c
1a+	Steamboat Slough	RM	24.7	R	911	2	2	3	3	3	3	3	3	4c	4c
1a	Steamboat Slough	RM	25.0	L	272	2		3		3		3		4c	

Bank Protection Measures Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Table 2-2. Continued

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1a+	Steamboat Slough	RM	25.8	R	244	2	2	3	3	3	3	3	3	4c	4c
1a	Steamboat Slough	RM	26.0	L	516	2		3		3		3		4c	
1a	Sutter Slough	RM	24.7	R	1,736	2		1		1		1		4c	
1a+	Sutter Slough	RM	26.5	L	568	2	2	3	3	4c	4c	4c	4c	4c	4c
1a	Willow Slough	LM	0.2	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Willow Slough	LM	0.7	L	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Willow Slough	LM	6.9	R	869	2		3		2		2		5	
1a	Yolo Bypass	LM	0.1	R	430	2		3		2		2		5	
1a	Yolo Bypass	LM	2.0	R	563	2		3		2		2		5	
1a	Yolo Bypass	LM	2.5	R	148	2		3		5		5		5	
1a	Yolo Bypass	LM	2.6	R	N/A	N/A		N/A		N/A		N/A		N/A	
1a	Yolo Bypass	LM	3.8	R	1,860	2		3		2		2		5	
1b	Lower American River	RM	7.3	R	N/A	N/A		N/A		N/A		N/A		N/A	
1b	Sacramento River	RM	21.5	L	162	2		3		4c		4c		4c	
1b	Sacramento River	RM	22.5	L	852	2		3		4c		4c		4c	
1b	Sacramento River	RM	22.7	L	309	2		3		3		3		4c	
1b	Sacramento River	RM	23.2	L	589	2		3		3		3		4c	

Bank Protection Measures Legend
N/A: No Action
1: Setback Levee
2: Bank Fill Stone Protection with No On-Site Woody Vegetation
3: Adjacent Levee
4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline
4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline
4c: Riparian and Wetland Benches with Revegetation
5: Bank Fill Stone Protection with On-Site Vegetation

Table 2-2. Continued

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1b	Sacramento River	RM	23.3	L	257	2		3		4c		4c		4c	
1b	Sacramento River	RM	24.8	L	782	2		3		2		3		4c	
1b	Sacramento River	RM	25.2	L	338	2		3		4c		4c		4c	
1b	Sacramento River	RM	31.6	R	446	2		3		5		5		5	
1b**	Sacramento River	RM	35.3	R	197	2		3		4a		4a		4a	
1b**	Sacramento River	RM	35.4	R	96	2		3		4a		4a		4a	
1b	Sacramento River	RM	38.5	R	359	2		1		5		5		5	
1b+	Sacramento River	RM	56.5	R	373	2	2	3	3	4b	4b	4b	4b	4b	4b
1b+	Sacramento River	RM	56.6	L	86	2	2	3	3	4a	4a	4a	4a	4a	4a
1b+	Sacramento River	RM	56.7	R	665	2	2	3	3	4b	4b	4b	4b	4b	4b
1b+***	Sacramento River	RM	58.4	L	707	2	2	3	3	5	5	5	5	5	5
1b+	Sacramento River	RM	60.1	L	455	2	2	3	3	4a	4a	3	3	4a	4a
1b+	Sacramento River	RM	62.9	R	175	2	2	3	3	4b	4b	4b	4b	4b	4b
1b+	Sacramento River	RM	63.0	R	87	2	2	3	3	4b	4b	4b	4b	4b	4b
1b	Sacramento River	RM	74.4	R	200	2		3		4b		4b		4b	
1b	Sacramento River	RM	75.3	R	2,761	2		3		5		3		5	
1b	Sacramento River	RM	77.7	R	224	2		3		5		5		5	

Bank Protection Measures Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Table 2-2. Continued

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
1b+	Sacramento River	RM	78.3	L	657	2	2	3	3	5	5	4b	4b	5	5
2	Bear River	RM	0.8	L	233	2		3		5		5		5	
2	Cherokee Canal	LM	14.0	L	N/A	N/A		N/A		N/A		N/A		N/A	
2	Cherokee Canal	LM	21.9	L	1,800	2		5		5		5		5	
2	Feather River	RM	0.6	L	288	2		3		4a		4a		4a	
2	Feather River	RM	5.0	L****	910	2		3		4a		4a		4a	
2	Sacramento River	RM	86.3	L	3,134	2		3		5		5		5	
2**	Sacramento River	RM	86.5	R	72	2		3		4b		4b		4b	
2	Sacramento River	RM	86.9	R	289	2		3		4b		4b		4b	
2	Sacramento River	RM	92.8	L	200	2		3		5		5		5	
2	Sacramento River	RM	95.8	L	190	2		3		5		5		5	
2	Sacramento River	RM	96.2	L	560	2		3		5		4b		5	
2	Sacramento River	RM	99.0	L	160	2		3		5		5		5	
2	Sacramento River	RM	101.3	R	352	2		1		4b		4b		4b	
2	Sacramento River	RM	103.4	L	N/A	2		N/A		N/A		N/A		N/A	
2	Sacramento River	RM	104.0	L	3,459	2		3		5		4b		5	
2	Sacramento River	RM	104.5	L	301	2		3		4a		4a		4a	

Bank Protection Measures Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Table 2-2. Continued

Region	Site Identification				Site Length (feet)	Bank Protection Measures by Alternative									
						Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
2	Sacramento River	RM	116.0	L	612	2		1		4a		4a		4a	
2	Sacramento River	RM	116.5	L	2,465	2		3		4a		1		4a	
2	Sacramento River	RM	122.0	R	248	2		3		4b		4b		4b	
2	Sacramento River	RM	122.3	R	341	2		1		4b		4b		4b	
2	Sacramento River	RM	123.3	L	208	2		3		4b		4b		4b	
2	Sacramento River	RM	123.7	R	120	2		3		4a		4a		4a	
2	Sacramento River	RM	127.9	R	801	2		1		5		4a		5	
2	Sacramento River	RM	131.8	L	339	2		1		4a		1		4a	
2	Sacramento River	RM	132.9	R	363	2		1		4a		4a		4a	
2	Sacramento River	RM	133.0	L	1,291	2		3		4a		4a		4a	
2	Sacramento River	RM	133.8	L	197	2		3		4a		4a		4a	
2	Sacramento River	RM	136.6	L	615	2		3		4a		4a		4a	
2	Sacramento River	RM	138.1	L	1,365	2		1		4a		1		4a	
2	Yuba River	LM	2.3	L	1,356	2		1		1		1		1	
3	Deer Creek	LM	2.4	L	496	2		3		5		3		5	
3	Elder Creek	LM	1.44	L	334	2		3		4a		4a		4a	
3	Elder Creek	LM	3.0	R	65	2		3		4a		4a		4a	

Bank Protection Measures Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Table 2-2. Continued

						Bank Protection Measures by Alternative									
Region	Site Identification				Site Length (feet)	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4A	Alt 4B	Alt 5A	Alt 5B	Alt 6A	Alt 6B
3	Elder Creek	LM	4.1	L	N/A	N/A		N/A		N/A		N/A		N/A	
3+	Sacramento River	RM	152.8	L	198	2	2	3	3	4b	4b	4b	4b	4b	4b
3+	Sacramento River	RM	163.0	L	1,213	2	2	3	3	4b	4b	1	1	4b	4b
3+	Sacramento River	RM	168.3	L	546	2	2	1	1	4b	4b	1	1	4b	4b
3+	Sacramento River	RM	172.0	L	525	2	2	1	1	4b	4b	1	1	4b	4b

+ Site is located within an economically justified basin.

* Design (setback or adjacent levee) combined with adjacent sites.

** Sacramento River 35.3R, 35.4R, and 86.5R have been repaired.

*** Though Sacramento River 58.4L is not a currently inventoried erosion site, nor has it ever been, it constitutes a representative site for the purposes of the programmatic SAM and EIS/EIR analyses. As previously described, additional project-level environmental documentation, tiering from this programmatic analysis, will be prepared to address those sites that will be constructed.

**** Feather River 5.0L was mistakenly called Feather River 4.9L in previous documents.

LM = levee mile; RM = river mile; L = left bank; R = right bank.

Bank Protection Measures Legend

N/A: No Action

1: Setback Levee

2: Bank Fill Stone Protection with No On-Site Woody Vegetation

3: Adjacent Levee

4a: Riparian Bank with Revegetation and Instream Woody Material above Summer/Fall Waterline

4b: Riparian Bench with Revegetation and Instream Woody Material above and below Summer/Fall Waterline

4c: Riparian and Wetland Benches with Revegetation

5: Bank Fill Stone Protection with On-Site Vegetation

Construction

Construction Activities

It is anticipated that construction would take place between April 1 and November 30, with in-water construction activities to be conducted between August 1 and November 30 (July 1 to August 31 in Reach 3). No water-based construction would be permitted during the winter months (December through March). Setback or adjacent levee construction may still occur during the winter months if feasible. The anticipated construction season may need to be modified to respond to high water levels in the river, the presence of special-status species, potential associated habitat disturbance, or other constraints.

Construction may take place from the landside or from the water. For water-based construction, work would be conducted from cranes mounted on barges, with the crane (boom) systems mechanically placing the rock along the shore and beneath the water line. Waterside construction typically would result in less noise, less roadway traffic, and less disturbance of vegetation than landside construction. For either landside or water-based construction, the contractor may choose to use excavators, loaders, and other construction equipment once the revetment has reached the summer/fall waterline.

Protective exclusion fencing would be installed to prevent construction crews from accessing sensitive resources, such as riparian habitat or elderberry shrubs, except where required for project implementation.

The Corps or CVFPB would be responsible for implementing the erosion repairs at individual sites.

Real Estate

The Corps will furnish to the state right-of-way maps indicting the areas required for construction, operations and maintenance, and on-site mitigation (if required). Prior to advertising of any construction contract, the state shall furnish all lands, easements, and rights-of-way, including suitable borrow and dredged material disposal areas or other disposal area as may be determined by the Corps to be necessary for construction and shall furnish to the Corps evidence supporting the state's legal authority to grant rights-of-entry to such lands. The process generally includes parcel research, coordination with landowners, acquisition of appropriate permits to allow further investigation, identifying and addressing existing encroachments, identification of rights to be acquired, appraisal and acquisition of property rights, and final clearing of encroachments. The state receives cost share credit for the lands, easements, and rights-of-way acquired. The credit shall be the fair market value of the interest at the time such interest is made available to the Corps for construction.

Staging Areas

Staging areas would be identified for each erosion site prior to construction. Staging areas typically are located within the erosion site construction easement or immediately adjacent to the erosion site, preferably in a location that does not affect or has a minimal impact on resources. These areas would be used for staging vehicles, materials, and other associated construction equipment. Staging areas would be subject to the same project-level environmental analysis and documentation as the project construction footprint to ensure that any potential resources would not be adversely affected or that appropriate mitigation is provided.

Haul Routes, Borrow Areas, Traffic, and Navigation

Depending on the site location, materials would be brought to the sites via waterways for water-based construction or via surface roads for land-based construction. Haul routes to those sites requiring landside access would be via Interstate and U.S. highways, state highways, county and city roads, and levee access roads. It is assumed that construction materials, including quarry stone, would be hauled from a commercial or previously permitted quarry or borrow site located within 100 miles of the site. Temporary lane closures and, in some instances, full road closures may be required. Adequate detours would be provided during any road closures. Construction signs would be posted along the haul routes, and flaggers would be used, as necessary, to minimize traffic problems and ensure public safety near the construction sites.

Barge navigation would be along waterways within the study area that are navigable, primarily along the Sacramento River, and would comply with all applicable navigation and mooring regulations.

Preferred Alternative

The Corps and CVFPB have identified Alternative 4A (and Sub-Alternative 4B) as the preferred alternative. The selection was made based on Alternative 4's ability to meet the project purpose and objectives, engineering and economic feasibility, and mitigation of environmental effects. Under this alternative, up to 80,000 LF of erosion protection will be constructed within economically justified basins. Based on the latest economic analysis, there are 7 economically-justified basins currently identified, and these are represented as Alternative 4B for the purpose of this analysis. The project would be implemented as Alternative 4B, but the basins that are included in this alternative may change as subsequent economic analysis is conducted. The Corps will continue to update the economic analysis approximately every 5 years and/or as erosion sites are identified in areas not evaluated. In addition, there may be some refinement of the determination of basins as units for this analysis through further engineering and economic assessment. Erosion sites identified outside economically justified basins will be referred to the nonfederal sponsor for construction through a Section 408 (33 USC Section 408) action, which would be triggered by the alteration of a federal project levee.

Environmentally Preferable Alternative/Environmentally Superior Alternative

NEPA requires identification of the environmentally preferable alternative and CEQA requires identification of the environmentally superior alternative. The environmentally preferable alternative is the alternative that best promotes NEPA's goals, while the environmentally superior alternative is that which substantially avoids or lessens the proposed project's significant environmental effects.

Alternative 3A is the environmentally superior alternative under CEQA and the environmentally preferable alternative under NEPA. While there are many similarities among the environmental effects associated with Alternatives 3A through 6A, Alternative 3A is superior because it minimizes construction-related effects associated with water quality, vegetation, fish, and wildlife, and is the most consistent with natural resource agency input received during the public scoping process. Although the No Action Alternative would cause fewer direct environmental effects than Alternative 3A, it would not meet the proposed program's purpose and need or objectives.

It should be noted that Alternative 3A is expected to have somewhat greater effects with regard to land use (primarily farmland), traffic and air quality. Additionally, Alternative 3A does not provide the most improvements to fish habitat as determined by the SAM when compared with Alternatives 4A through 6A. However, Alternative 3A would cause the least disruption to existing fish/riparian habitat and provide substantial opportunities for floodplain restoration and the continuation of natural erosion processes. Effects on land use and higher costs associated with land purchase and construction are considered substantial challenges to Alternative 3A.

Restoration/Mitigation Establishment and Monitoring

Vegetation establishment and monitoring would be necessary to ensure that the mitigation vegetation is successfully establishing and that the IWM is functioning as intended. Following completion of construction at an individual site, the Corps would submit a detailed maintenance and monitoring plan (MMP) for the resource agencies to review. The MMP would include: 1) success criteria to provide a standard to assess whether mitigation efforts successfully replace lost habitat value; 2) a program to monitor the development of SRA cover and riparian habitat; 3) a protocol for implementing remedial actions should any success criteria not be met; and 4) the required duration of the monitoring efforts. Monitoring reports that evaluate the progress of each constructed erosion site in meeting the success criteria would be submitted to the resource agencies by December 31 of each monitoring year.

Vegetation establishment activities for on-site mitigation will be performed by the Corps for a minimum of 3 years and until mitigation success criteria has been met following the completion of levee repairs. After this time, it is anticipated that the vegetation would be established and self-sustaining. Anticipated activities during the 3-year establishment period include removal of problematic invasive species, irrigation of vegetation to promote optimal growth, replacement of any dead or declining vegetation, and maintenance of beaver barrier fencing.

Establishment activities also may include monitoring the vegetation and IWM to ensure that hazards to navigation are not present, assessing the status of the rock revetment and soil fill during high-flow events, and monitoring the sites for vandalism. Any in-water maintenance work would be conducted in coordination with the applicable federal and state resource agencies to avoid adverse effects on sensitive fish species.

Long-term maintenance is the responsibility of the project sponsor, which is the CVFPB. In most cases, the CVFPB delegates long-term maintenance to a local maintaining agency, such as a reclamation or levee district. Maintenance is to be carried out consistent with the Sacramento Flood Control Project Operations and Maintenance manual.

Chapter 3
Guide to Effects Analysis

Introduction

This chapter provides guidance on NEPA and CEQA requirements, the use of NEPA and CEQA terminology, and the structure of the resource chapters.

NEPA and CEQA Requirements

An EIS prepared under NEPA is essentially the same as an EIR prepared under CEQA because both are public disclosure documents to ensure environmental factors are considered during the government decision-making process.

The Council on Environmental Quality regulations for implementing NEPA specify that a federal agency preparing an EIS must consider the effects of the proposed action and alternatives on the environment. These include effects on ecological, aesthetic, historical, and cultural resources, and economic, social, and health effects. Environmental effects are categorized as direct, indirect, and cumulative.

An EIS also must discuss possible conflicts with the objectives of federal, state, regional, and local land use plans, policies, or controls for the area concerned; energy requirements and conservation potential; urban quality; the relationship between short-term uses of the environment and long-term productivity; and irreversible or irretrievable commitments of resources. An EIS must identify relevant, reasonable mitigation measures not already included in the proposed action or alternatives that could avoid, minimize, rectify, reduce, eliminate or compensate for the project's adverse environmental effects (40 CFR Sections 1502.14, 1502.16).

The State CEQA Guidelines for implementing CEQA provide that the environmental analysis for an EIR must evaluate impacts associated with the project and identify mitigation for any potentially significant impacts. All phases of a proposed project, including construction and operation, are evaluated in the analysis. Section 15126.2 of the State CEQA Guidelines states:

> An EIR shall identify and focus on the significant environmental effects of the proposed project. In assessing the impact of a proposed project on the environment, the lead agency should normally limit its examination to changes in the existing physical conditions in the affected area as they exist at the time the notice of preparation is published, or where no notice of preparation is published, at the time environmental analysis is commenced. Direct and indirect significant effects of the project on the environment shall be clearly identified and described, giving due consideration to both the short-term and long-term effects. The discussion should include relevant specifics of the area, the resources involved, physical changes, alterations to ecological systems, and changes induced in population distribution, population concentration, and human use of the land (including commercial and residential development), health and safety problems caused by the physical changes, and other aspects of the resource base such as water, historical resources, scenic quality, and public services. The EIR shall also analyze any significant environmental effects the project might cause by bringing development and people into the area affected.

An EIR also must discuss inconsistencies between the proposed project and applicable general plans and regional plans (State CEQA Guidelines Section 15125[d]).

An EIR must describe any feasible measures that could minimize significant adverse impacts, and the measures are to be fully enforceable through permit conditions, agreements, or other legally binding instruments (State CEQA Guidelines Section 15126.4[a]). Mitigation measures are not required for impacts that are found to be less than significant.

Under NEPA, the effects of the proposed action and alternatives under consideration, including the no action alternative, are determined by comparing effects between alternatives and against effects from the no action alternative. Consequently, baseline conditions differ between NEPA and CEQA. Under NEPA, the no action alternative (i.e., expected future conditions without the project) is the baseline to which the action alternatives are compared, and the no action alternative is compared with existing conditions. Under CEQA, existing conditions are the baseline with which all alternatives are compared.

Application of NEPA and CEQA Principles and Terminology

NEPA and CEQA are similar in that both laws require the preparation of an environmental study to evaluate the environmental effects of proposed government actions. However, there are several differences between the two regarding terminology, procedures, environmental document content, and substantive mandates to protect the environment. For this environmental evaluation, the more rigorous of the two laws was applied in cases in which NEPA and CEQA differ. In other words, where there are CEQA requirements that go beyond NEPA's requirements, this evaluation follows the CEQA requirements; and where there are NEPA requirements that go beyond CEQA's requirements, this evaluation will follow the NEPA requirements. For example, CEQA requires consideration of non-federal listed plants and wildlife in the biological effect analysis; however, NEPA is primarily concerned with only federal listed plants and wildlife. CEQA also requires consideration of local- and state-listed historical resources in the cultural resources analysis, while NEPA is primarily concerned with resources on or eligible for the National Register of Historic Places. Additionally, CEQA does not require an environmental justice evaluation, nor does it require compliance with the Section 106 process of the National Historic Preservation Act; however, both are required under NEPA.

Many concepts are common to NEPA and CEQA; however, the laws sometimes use differing terminology for these common concepts. Table 3-1 below provides a comparison of NEPA and CEQA terminology.

Table 3-1. Key to General NEPA and CEQA Terminology

NEPA Term	Correlating CEQA Term
Lead Agency	Lead Agency
Cooperating Agency	Responsible Agency
Environmental Impact Statement	Environmental Impact Report
Record of Decision	Findings
Preferred Alternative	Proposed Project
Project Purpose	Project Objectives
No Action Alternative	No Project Alternative
Affected Environment	Environmental Setting
Effect	Impact

This EIS/EIR uses both NEPA and CEQA terminology in certain instances (e.g., in Chapter 1 where the project purpose and need, and project objectives are discussed).

The terms "environmental consequences," "environmental impacts," and "environmental effects" are considered synonymous in this analysis, and "effects" is used for consistency. Similarly, in general, the terms "significant" and "less than significant" are used rather than "adverse" and "not adverse."

Technical terms used in the EIS/EIR are typically defined in their first instance of use in the text. A list of acronyms and abbreviations follows the Table of Contents and an index follows Chapter 26.

Resource Chapters

The resource chapters contain analyses of the environmental effects, by resource area, associated with the No Action Alternative and Alternatives 2A through 6A. Effects associated with the sub-alternatives (2B through 6B) are discussed in a separate chapter (Chapter 21, Effects of Implementation in Economically Justified Basins Only). The resource chapters are as follows:

- Chapter 4, Flood Control and Geomorphology
- Chapter 5, Water Quality and Groundwater Resources
- Chapter 6, Geology, Seismicity, Soils, and Mineral Resources
- Chapter 7, Transportation and Navigation
- Chapter 8, Air Quality and Climate Change
- Chapter 9, Noise and Vibration
- Chapter 10, Vegetation and Wetlands
- Chapter 11, Fisheries and Aquatics
- Chapter 12, Wildlife
- Chapter 13, Land Use and Agriculture
- Chapter 14, Recreation
- Chapter 15, Population and Housing

- Chapter 16, Utilities and Public Services
- Chapter 17, Aesthetics
- Chapter 18, Public Health and Environmental Hazards
- Chapter 19, Cultural Resources
- Chapter 20, Socioeconomics and Environmental Justice

Contents of Resource Chapters

Each resource chapter contains the information listed here.

- **Affected Environment** contains two sections, "Environmental Setting" and "Regulatory Setting." These sections include the following information.
  - **Environmental Setting.** This section provides an overview of the physical environmental conditions in the area at the time of or prior to the publication of the Notice of Preparation that could be affected by implementation of the proposed alternatives in accordance with NEPA regulations (40 CFR Section 1502.15) and State CEQA Guidelines Section 15125.
- **Regulatory Setting.** This section refers the reader to Appendix C, Regulatory Background, which lists and describes laws, regulations, policies, and plans that affect the resource or the assessment of impacts on the resource. Often the regulatory framework is the basis for the significance criteria and, therefore, plays a crucial role in impact assessment. Potentially applicable regulations are discussed, including local policies from municipal general plans and ordinances.
- **Environmental Consequences** describes the analysis of effects relating to each resource area for each of the alternatives in accordance with NEPA regulations (40 CFR Section 1502.16) and with State CEQA Guidelines Sections 15126, 15126.2, and 15143. This section includes the following information.
  - **Methods and Assumptions** describes the methods, models, process, procedures, data sources, and/or assumptions used to conduct the impact analysis. Where possible, impacts are evaluated quantitatively. Where quantification is not possible, impacts are evaluated qualitatively.
  - **Determination of Effects** provides the criteria used in this document to define the level at which an effect would be considered significant in accordance with CEQA. Significance criteria (sometimes called "thresholds of significance") used in this EIS/EIR are based on the checklist presented in Appendix G of the State CEQA Guidelines; factual or scientific information and data; and regulatory standards of federal, state, and local agencies. Under NEPA, preparation of an EIS is triggered if a federal action has the potential to "significantly affect the quality of the human environment," which is based on the context and intensity of each potential effect. The significance thresholds used in this EIS/EIR also encompass the factors taken into account under NEPA to evaluate the context and the intensity of the effects of an action.
  - **Effects and Mitigation Measures.** To comply with NEPA and CEQA, the effects/impacts are considered and evaluated as to whether they are direct, indirect, or cumulative. Direct effects are those that are caused by the action and occur at the same time and place. Indirect effects are reasonably foreseeable consequences to the physical environment that may

occur at a later time or at a distance from the project area. Cumulative effects are discussed in Chapter 22, Growth-Inducing and Cumulative Effects.

Effects are listed numerically and sequentially throughout each chapter. An effect statement precedes the discussion of each effect and provides a summary of the effect topic. The numbering system provides a mechanism for tracking unique effects by resource area.

Each effect is accompanied by a finding or conclusion, as required under NEPA and CEQA. Table 3-2 provides a key for relating the effect findings by relative severity (increasing in degree of adversity to the environment).

Table 3-2. Effect Findings (by increasing adversity)

Finding
Beneficial
No Effect
Less than significant
Significant
Significant and Unavoidable

For the purposes of the analyses in this document, the effect findings are defined more specifically below.

- **Beneficial.** This effect would provide a benefit to the environment as defined for that resource.
- **No Effect.** This effect would cause no discernible change in the environment as measured by the applicable significance criterion; therefore, no mitigation would be required.
- **Less than Significant:** This effect would cause no substantial adverse change in the environment as measured by the applicable significance criterion; therefore, no mitigation would be required.
- **Significant:** This effect would cause a substantial adverse change in the physical conditions of the environment. Effects determined to be significant based on the significance criteria fall into two categories: those for which there is feasible mitigation available that would reduce the environmental effects to less-than-significant levels, and those for which there is either no feasible mitigation available or for which, even with implementation of feasible mitigation measures, there would remain a significant adverse effect on the environment. Those effects that cannot be reduced to a less-than-significant level by mitigation are identified as significant and unavoidable, described below.
- **Significant and Unavoidable**. This effect would cause a substantial adverse change in the environment that cannot be avoided or mitigated to a less-than-significant level if the project is implemented. Even if the effect finding is still considered significant with the application of mitigation, the Corps and CVFPB are obligated to incorporate all feasible measures to reduce the severity of the effect.
- **Mitigation Measures.** Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant effects accompany each impact discussion. Similar to the effect descriptions, mitigation measures are listed numerically and sequentially throughout each section. A mitigation measure statement precedes the discussion of each measure and provides

a summary of the measure topic. The numbering system provides a mechanism for tracking unique measures by resource area.

Chapter 4
Flood Control and Geomorphology

Introduction and Summary

This chapter describes the environmental setting associated with hydrologic, hydraulic, geomorphic, and flood control issues, the determination of effects, the environmental effects on hydrologic, hydraulic, geomorphic, and flood control issues that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

Implications of programmatic alternatives for flood control and geomorphic conditions are also addressed within the context of the resources affected by the changes, most notably water quality and groundwater resources (Chapter 5); geology, seismicity, soils, and mineral resources (Chapter 6); vegetation and wetlands (Chapter 10); and fisheries and aquatics (Chapter 11).

The key sources of data and information used in the preparation of this chapter are listed below.

- 2008—Field Reconnaissance Report of Bank Erosion Sites and Site Priority Ranking, Sacramento River Flood Control Levees, Tributaries, and Distributaries (Ayres Associates, 2008).
- Geomorphic Analysis and Bank Protection Alternatives Report for Sacramento River (RM 78–194) and Feather River (RM 0–28) (WET 1990a).
- Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II (Final) (Stillwater Sciences 2007).
- Final EIR/SEIS for the Sacramento River Bank Protection Project (Jones & Stokes Associates 1987).
- Historic Sediment Loads in the Sacramento–San Joaquin Delta (California Department of Water Resources 1994).
- West Sacramento Levees System: Problem Identification Report, Erosion Assessment and Treatment Alternatives, Draft for Review (Northwest Hydraulic Consultants 2007).
- Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites: Sacramento River Bank Protection Project (U.S. Army Corps of Engineers 2009).
- Geomorphic Analysis of Reach from Colusa to Red Bluff Diversion Dam, River Mile 143 to River Mile 243: Final Phase II Report (WET 1989).
- Geomorphic Analysis of the Sacramento River, Phase II Report (WET 1990b).
- Assessment of Sediment Budget of Sacramento–San Joaquin Delta (Northwest Hydraulic Consultants 2003).
- North Delta Sedimentation Study (Northwest Hydraulic Consultants 2006).
- Final Alternatives Report—80,000 LF (107 Sites), Sacramento River Bank Protection Project (Kleinfelder-Geomatrix 2009).

Table 4-1 summarizes the flood control and geomorphic effects resulting from the implementation of the Proposed Action.

Table 4-1. Summary of Flood Control and Geomorphology Effects and Mitigation

Effect	Mitigation Measure	Implementation Period
FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment	FCGEOM-MM-1: Conduct Site-Specific Studies at Levee Repair Sites and Minimize Changes in Local Hydraulic Conditions through Project Design	As needed before project (site) design and implementation
FCGEOM-2: Increase in Levee Slope Stability	Not applicable	
FCGEOM-3: Decrease in Instream Woody Material Recruitment	FISH-MM-2: Compensate for Loss of Fish Habitat VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	During and after construction. Develop revegetation plan prior to removal of existing riparian vegetation. Plantings will be monitored over a minimum period of time, as determined by the appropriate state and federal agencies.
FCGEOM-4: Changes in Local Hydraulics and Shear Stress	FCGEOM-MM-1: Conduct Site-Specific Studies at Levee Repair Sites and Minimize Changes in Local Hydraulic Conditions through Project Design	As needed before project (site) design and implementation
FCGEOM-5: Minimization of Stream Energy and Associated Floodplain Scour and/or Deposition	Not applicable	
FCGEOM-6: Substantially Alter the Existing Drainage Pattern of the Site or Area	FCGEOM-MM-2: Coordinate with Owners and Operators, Prepare Drainage Studies as Needed, and Remediate Effects through Project Design	As needed before project (site) design and implementation

Environmental Setting

Program Area Description

The program area encompasses more than 1,000 miles of levees and weirs. This area extends south-to-north along the Sacramento River, from the town of Collinsville (River Mile [RM] 0) upstream to Chico at RM 194. The program area also includes Cache Creek, the lower reaches of Elder and Deer

Creeks, the lower reaches of the American River (RM 0–23), Feather River (RM 0–61), Yuba River (RM 0–11), and Bear River (RM 0–17), portions of Threemile, Steamboat, Sutter, Miner, Georgiana, and Cache Sloughs, as well as a number of flood bypasses and distributaries (Figure 2-1).

Flood Control

Sacramento River Flood Control Project

The development of flood control along the Sacramento Valley rivers has been described as follows (U.S. Army Corps of Engineers 1972):

Prior to the beginning of agricultural development in the highly fertile Sacramento Valley, a large part of the area was subject to periodic inundation by flood flows from Sacramento River and its tributaries. The floodplain, varying in width from about 2 to 30 miles, was about 250 miles long from the mouth of the river to the vicinity of Red Bluff, and covered more than 1 million acres. Much of the floodplain was covered with a dense growth of tule. Between the river bank and the tule lands were areas of higher ground called rimlands, formed by sediment deposits along the channels. The rimlands formed low natural levees which were accessible by water transportation. Because they were susceptible to only occasional flooding, the rimlands were the first to be occupied and developed for agriculture.

Prior to 1850, some low levees were constructed by individual landowners, and by 1894 there were many miles of levees along the river and along adjacent stream channels. Some areas were formed into districts around which levees were constructed to provide flood protection. Many such districts were islands surrounded by leveed waterways. However, as additional levees were constructed, high water levels were raised and other areas became subject to flooding due to increased flood heights.

Flooding problems were aggravated by hydraulic mining in the upstream areas between 1853 and 1884. During this period, millions of tons of mining debris (silt, sand, and gravel) were deposited in the mountain and valley streams. The beds of the Sacramento, Feather, Yuba, Bear, and American Rivers increased as much as 20 feet in some reaches. By the mid-1870s, adjacent agricultural lands were being flooded and covered with hydraulic mining debris to such an extent that agricultural interests filed suit against the mining companies and, in 1884, a United States 9th Circuit Court decree, in what became known as the Sawyer Decision in *Woodruff v. North Bloomfield Mining and Gravel Company*, stopped virtually all hydraulic mining operated without a means of restraining debris. In 1893, the Congress passed the Caminetti Act (33 United States Code Section 661 et seq.), which created the California Debris Commission and gave it the responsibility of regulating hydraulic mining activities, improving the navigability of rivers in the Central Valley, and controlling floodwaters.

A number of alternative plans were considered by the Debris Commission for flood prevention along the Sacramento River and its tributaries, including storage reservoirs, confining the rivers to single main channels, and improving the river channels to maximum capacity supplemented by leveed floodway bypasses. The leveed floodway bypass concept was adopted by the Commission and is the basis for the existing Sacramento River Flood Control Project (SRFCP).

The SRFCP was authorized by Congress in 1917 (Public Law 64-367, Section 2, 39 Statutes 948, 949 (1917)). The SRFCP was the major project for flood control on the Sacramento River and its tributaries. It was sponsored by The Reclamation Board of the State of California (today reauthorized as the Central Valley Flood Protection Board, or CVFPB) and was the first federal flood control project constructed outside of the Mississippi River Valley.

The SRFCP includes more than 1,000 miles of levees, overflow weirs, pumping plants, and bypass channels. Currently, the SRFCP extends from the Sacramento River's mouth near Collinsville in the Sacramento-San Joaquin Delta (Delta) to near Chico Landing in the northern Sacramento Valley. More than 1,000 miles of levees were constructed as part of the project, providing flood protection to roughly 800,000 acres of highly productive agricultural lands, the cities of Sacramento and Marysville, and numerous other small communities. Although SRFCP levees often were constructed of poor foundation materials such as river dredge spoils that would not meet current engineering standards, the levees are relied upon to provide flood protection during major storms to more than 2 million people in approximately 50 communities with an estimated $37 billion in urban and agricultural development.

Climate

The program area has a mild, Mediterranean-type climate. Mean annual temperature in West Sacramento, which is used as an example because its climate is representative of a majority of the entire program area, is a relatively mild 62.2°F. Average high temperatures during the summer range from 87.1°F–93.1°F. Temperatures sometimes exceed 100°F. Winter temperature maximums vary from 54.5°F–60.6°F. Average low temperatures in the winter range from 40.2°F–43.7°F. Temperatures in the winter only occasionally drop below freezing (Andrews 1972). Farther south in Rio Vista, the temperatures are generally cooler year round due to the influence of cool air movement from the Carquinez Strait (locally referred to as the "Delta breeze"). In the north part of the program area, maximum annual temperatures are higher due to the decreasing influence of cool air movement from the Carquinez Strait. For example, the average high temperature for Chico in July is 94 °F and temperatures frequently exceed 100°F.

In West Sacramento, average annual precipitation is about 18 inches, with approximately 80% of the total rainfall occurring between November and March. Cloud-free skies generally prevail throughout the summer months, and in much of the spring and fall. Thunderstorms are relatively infrequent, although occasionally occur in the late summer and other times of the year when unstable air masses are situated over the region. The highest rainfall generally occurs in January, when the average is about 4.2 inches of precipitation. The driest month is July, during which rainfall is rare. Average annual precipitation farther south in Rio Vista is similar to that of West Sacramento; however, average annual precipitation amounts increase farther north in the program area. For example, Chico's average annual precipitation is 27 inches.

The temporal variability in precipitation is related to seasonal variation in atmospheric conditions. During the summer months, high pressure systems build over the Pacific Ocean off the California coast, promoting the transport of cool, dry air from the north. This effectively blocks major sources of moisture. During the winter rainy season, the jet stream migrates farther south, allowing low pressure systems off the California coast to create conditions that transport moisture inland. Extreme variability of rainfall averages is indicative of wet and dry cycles. In West Sacramento, during Water Years 1986, 1993, 1995, 1996, and 2005, total rainfall was significantly higher than normal, with annual precipitation measured at 30.15, 29.41, 24.79, 23.74, and 19.95 inches, respectively (California Department of Water Resources 2009). Recent dry periods include the 1976–77 and 1987–1992 drought years, with precipitation far below average because of the prevalence of stable, high-pressure systems during those winter months.

Hydrology and Hydraulics

Flood Basins of the Sacramento Valley

As early as 1917, the importance of natural flood basins to the Sacramento Valley river system was recognized by Gilbert (1917). Flood basins in the Sacramento Valley were originally delineated by Gilbert (1917). More recently, Ayres Associates (2008) divided the entire Sacramento River basin into potential flooded areas, based on what land would be flooded if a levee failed. The Sacramento River basin was divided into 26 subbasins.

Gilbert (1917) described these flood basins as being inundated annually by floodwaters. The Sacramento River was separated from the flood basins by natural levees; however, at high water, these levees were easily overtopped. The lower 25 miles of the Feather River is also bounded by flood basins (WET 1990a).

Hall (1880 as cited in WET 1990a) describes the inundation of the flood basins during the flood of 1879:

> "During the high water of March 1879, the low lands of the Sacramento Valley, to the extent of about 847 square miles, were covered with water; this area includes all flooded for a short period of time, as well as that upon which the water rested for several months. Above the mouth of the Feather River, in what may be called the upper flood region, the area covered was about 483 square miles; and below that point, in what is called the lower flood region, the flooded area was about 364 square miles in extent."

Gilbert (1917 as cited in WET 1990a) emphasized the hydrologic significance of the natural flood basins:

> "The lateral basins affected the channel characters in several ways. They conveyed a large part of the flood discharge and thus left for adjacent portions of the channel only a small part. They acted as reservoirs for the storage of floodwaters and fed them gradually to the lower course of the Sacramento, so that the channels in the delta region were only moderately taxed by the floods. The channels in consequence were adjusted for conveyance of only a fraction of the flood discharge; they were of moderate section and their meanders were of small radius. Between the town of Colusa and the mouth of the Feather River, the Sacramento River grows gradually downstream until its estimated capacity is only 10 percent of the flood discharge."

Because the flood basins have been maintained as topographic lows even though there has been extensive overbank deposition, it is evident that the flood basins have been subsiding at a rate equal to or exceeding that of overbank deposition (Gilbert 1917 as cited in WET 1990a; WET 1989 as cited in WET 1990a; Harvey 1988 as cited in WET 1990a). Such widespread subsidence may be driven by ongoing structural deformation of the Sacramento Valley. Offset on the Willows fault may have generated an east-dipping topographic gradient on the eastern, upthrust block. Rotation of the downthrust block would generate a similar gradient (WET 1990a). See Chapter 6, Geology, Seismicity, Soils and Mineral Resources, for further information about land subsidence within the program area.

In brief, the Sacramento Valley flood basins play a key role in the fluvial geomorphology and hydrology of the Sacramento River (and other water courses in the program area). Most importantly, the overflow areas cause the Sacramento River to get smaller downstream. In addition, suspended sediment that has been deposited historically in the flood basins has generated a thick, cohesive stratigraphic unit, which adds to the bank stability of the lower Sacramento River. The significance of these flood basin deposits increases downstream as the topographic lows become more pronounced between Chico and Verona (WET 1990a).

Naming Conventions

This analysis uses the naming conventions adopted by Stillwater Sciences (2007) to subdivide the program area into regions with similar physical/biological characteristics. For the purposes of this analysis, the program area is divided into four regions, organized south to north by the location of the downstream terminus of each watercourse with the mainstem Sacramento River (Table 2-1 and Figure 2-1). As defined in Table 2-1, Region 1a encompasses the Yolo and Sacramento Bypasses, the Sacramento River from Collinsville to Isleton (RM 0–20), and a distribution network of sloughs and channels; Region 1b encompasses the Sacramento River from Isleton to the Feather River (RM 20–80); Region 2 encompasses the Sacramento River from Feather River confluence to Colusa (RM 80–143), as well as the Feather River from the Sacramento River confluence to Oroville (RM 0-67) and its tributaries; and Region 3 encompasses the Sacramento River from Colusa to Chico (RM 143–194).

Regional Hydrology

The Sacramento River watershed receives winter/early spring precipitation in the form of rain and snow (at higher elevations) in the northern Sierra Nevada, northern Coast Range, and Southern Cascades. Prior to the construction and operation of reservoirs, winter rainfall events caused extensive flooding and spring snowmelt resulted in high flows during spring and early summer. Summer and fall flows were historically low. Currently, much of the total runoff is captured and stored in reservoirs for gradual release during the summer and fall months. High river flows occur during the winter and spring, but these are usually lower than during pre-European settlement times; summer and fall low flows are sustained by releases from upstream reservoirs (Stillwater Sciences 2007).

Examined quantitatively, the regulated 10,000 cubic feet per second low flow (in Region 3) is increased about five fold during the average annual high flow event (U.S. Army Corps of Engineers 1981). The average is not typical, however, since both drought years and massive runoff events present great streamflow variation. In 1977, for example, the peak runoff was only about 50% higher than the average low flow. On the other hand, individual storm sequences, such as those of the week of February 7, 1986, can generate runoff some 26 times the average annual flow, and the estimated 100-year floodflow would be even higher. Much of the runoff during these large flood events is diverted from the main channel to the flood control bypass system (Jones & Stokes Associates 1987).

There is significant variability in flows for the different rivers and creeks in the program area. This variability in flow influences the magnitude of bank erosion for particular rivers and creeks. In general, the Sacramento River has the largest flows of any watercourse in the program area and as such experiences the highest rates of bank erosion.

Geomorphic Conditions

The Sacramento Valley is the northern portion of the Great Central Valley of California. The river basin is an elongated synclinal trough, which is bounded by the Sierra Nevada plutonic complex to the east and the Coast Ranges to the west. The Sacramento Valley is underlain by marine sedimentary rocks overlain by recent alluvial deposits and, to a lesser extent, some volcanic rocks. The levees and river sediments associated with the program area are composed of Quaternary alluvium deposits that consist of loose to medium-dense, unweathered gravel, sand, silt, and clay. These sediments are estimated to have been deposited 200 to 10,000 years before present in naturally formed riverbanks and floodplains along the Sacramento River (Helley and Harwood 1985 as cited in U.S. Army Corps of Engineers 2009).

In geologic history, the Sacramento River migrated frequently and freely within its meander belt, which typically exceeded several thousand feet in width (Buer 1984 as cited in U.S. Army Corps of Engineers 2009). Prior to Euro-American settlement, the mainstem Sacramento River and tributaries along the valley floor would naturally overtop its banks at regular cycles and flood the adjacent lands, replenishing wetlands and depositing sediments. Despite overbank sediment deposition, these flood basins have maintained a low topographic profile, which suggests that the flood basins are subsiding at a rate equal to or greater than overbank deposition (Gilbert 1917 as cited in U.S. Army Corps of Engineers 2009; WET 1989 as cited in U.S. Army Corps of Engineers 2009). These floodplains have historically provided crucial fluvial geomorphic roles for the Sacramento River and other rivers and creeks in the program area, as the flow loss to the flood basins causes the Sacramento River to downsize in the downstream direction in the lower reaches (WET 1990b as cited in U.S. Army Corps of Engineers 2009).

Beginning in the late 1800s, the Sacramento River's channel morphology and sediment transport regime have been progressively altered by human activities, including the clearing of riparian vegetation and the construction of levees and upstream dams for flood control and water supply. Bank armoring of the levees has resulted in lower sinuosity, fewer overbank flows, and an altered pattern of channel migration and meander cutoff (Brice 1977 as cited in U.S. Army Corps of Engineers 2009; Larsen et al. 1997, 2004 as cited in U.S. Army Corps of Engineers 2009; Larsen and Greco 2002). The present-day Sacramento River is a single-thread channel, which transitions from a coarse gravel bed upstream into a sand-bedded channel (by about RM 128), with occasional outcrops of cemented alluvial deposits (such as the Modesto Terrace formation) that historically provided natural constraints to lateral migration (U.S. Army Corps of Engineers 2009).

See Chapter 6, Geology, Seismicity, Soils and Mineral Resources, for a description of sedimentology within the program area.

Regions 1a and 1b

The present geomorphic state of the lower Sacramento River basin and the Delta is a function of the intensity of water management in each of the tributary rivers, local farming practices, intra- and inter-Delta water transfers, and an extensive human-made levee system. Today, channel alignments are largely fixed by artificial levees and erosion control measures. Flooding, except when artificial levees break, no longer occurs on most islands and tracts. Instead, flow and sediment remain confined to the existing channel network. Upstream water diversions for municipalities and agriculture reduce the amount of flow entering the Delta and the amount of sediment transported to the Delta. In addition, conveyance of water within and out of the Delta alters flow directions and affects sedimentation and erosion rates and patterns. The levee system in the Delta restricts flow to a network of human-made and natural channels that reduce flood events and inhibit the accumulation of soils on the Delta islands.

Historical changes in the lower Sacramento River basin and Delta that have affected channel morphology include land reclamation, levee construction, dredging, hydraulic mining, impoundment of water and sediment by upstream dams and other diversions, and the construction of water diversion facilities and consequent alteration of flow and sedimentation patterns in the Delta. The effects of these changes on channel morphology in the program area are summarized below.

- Waterways in the program area are largely confined by levees and able to convey significantly greater flow and sediment discharges than during historical times.
- Historical cross-section data indicate that the majority of waterways in the lower portion of the program area have experienced some channel incision over the several decades and may be experiencing a net sediment loss over time.
- Water regulation, diversions, and the impoundment of water and sediment by dams has resulted in a decline in the total annual water and sediment outflows to the Delta from the Central Valley, a trend that is expected to continue into the future (Northwest Hydraulic Consultants 2003).
- The construction of large water diversion facilities such as the Delta-Mendota Canal and Delta Cross Canal in 1951 and California Aqueduct in 1973 have altered the traditional flow patterns in the Delta that affect sedimentation. Water and sediment exhibit a more southerly flow in the Delta, somewhat reducing deposition of sediment in the north and central Delta and increasing deposition of sediment in the south Delta (Northwest Hydraulic Consultants 2003).
- The combination of overgrazing, deforestation, floodplain reclamation, river channelization, and most importantly, hydraulic mining for gold caused large increases in sediment loads in the Delta system. The historical trend demonstrates a rapid decline of sediment loads in the Delta streams at the beginning of the twentieth century, followed by a gradual, steady increase of sediment loads over the last half century (Northwest Hydraulic Consultants 2003).
- Historically, some deposition of the solids occurred at locations in the Delta channels where water velocities were low. During high-flow periods, a high percentage of these solids were re-suspended and moved downstream toward San Francisco Bay.

For a complete review of the historical geomorphology of the Delta region, refer to Northwest Hydraulic Consultants' 2006 North Delta Sedimentation Study.

Sediment Inputs to the Delta

Most of the sediment supplied to the Delta (between 80% and 85% in an average year) is carried by the Sacramento River, whereas the San Joaquin River and the Mokelumne-Cosumnes River supply only about 10% and 4%, respectively (Northwest Hydraulic Consultants 2003). The remaining sediment enters the system from the Yolo Bypass and from several other smaller tributaries and sloughs. The Sacramento River is a sand-bed river; sediments transported through the lower portion of the program area include sands, silts, and clays.

The SRFCP conveys released reservoir waters from various upstream sources and stormwater runoff through the Delta and into San Francisco Bay. These waters contain dissolved and undissolved solids, both of which are transported through the system. Undissolved solids—sediment—consist primarily of clay-, silt-, and sand-sized particles. Before construction of the flood control and conveyance system, the natural flow of freshwater runoff from the upstream mountainous regions transported significant quantities of silt and clay particles. Because of the wide expanse and flat terrain of the program area, these particles would settle and form the sediments of the Delta alluvial plain. During the wet season, when the volume of runoff water was much larger, the quantity of suspended and unsuspended solids was significant and included sands and, in some cases, gravels.

The natural processes described above continue today but in a modified manner. Much of the naturally eroded and transported solid particles now settle out in instream water storage reservoirs. A percentage of the fine solids, like silts and clays, still are transported during water releases that enter the system from waterways downstream of the reservoirs. These sediments enter the Delta channels, and rather than settling out in the alluvial plain (as occurred before the channels were constructed), they now remain within the leveed channels.

For a description of total suspended sediment and turbidity see Chapter 5, Water Quality and Groundwater Resources.

Region-Specific Description (Region 1a)

Below Isleton (RM 20), the Sacramento River flows into the Delta, forming a distribution network of sloughs and channels. Flow is additionally received via the Yolo Bypass, which is a leveed, wide floodplain that flows parallel to the west of the mainstem Sacramento River during high flows. Additional flow comes from several water courses that feed into the bypass, including Knights Landing Ridge Cut, Cache Creek, Willow Slough Bypass, Sacramento Bypass, and Putah Creek. Seasonal high flows enter the Yolo Bypass from the Sacramento River via the Fremont Weir (RM 83) and the Sacramento Bypass Weir (RM 63). Flow velocities are low because flow is distributed throughout the Delta channels and sloughs that are bordered by relatively low levees consisting of both natural bank materials and revetment (Jones & Stokes Associates 1987). These levees and bank protection structures currently prevent the river’s access to historical tidal wetlands and islands. Tidal influence extends up the Sacramento River for 80 miles to Verona, with the greatest tidal variation concentrated in the Delta. The major tidal sloughs included within the program area are Threemile, Georgiana, Steamboat, Miner, Lindsay, Cache, Haas, and Sutter sloughs.

Sloughs and channels in this region are generally confined on both sides by natural levees enhanced by decades of man-made improvements. The individual channels and sloughs are moderately sinuous, of uniform width, and do not migrate. Compared with the upper regions (Regions 2 and 3), impacts of seasonal flood events are much less due to both tidal action and the diversion of flow through the upstream flood bypasses and outtakes (U.S. Fish and Wildlife Service 2001 as cited in Stillwater Sciences 2007). Historically, channel and slough morphology actively adjusted throughout the Delta in response to seasonal variations in flow and sediment load. The decrease in flow velocities caused the deposition of a gradient of coarser to finer material from upstream to downstream (fine sand to clayey silt). The intertidal deposits that border the Delta channels and sloughs are typically characterized by shallow, alternating layers of fine sandy silt and clayey silt, with occasional peaty muds. Artificial fill from hydraulic dredge spoils was placed after 1900 throughout the Delta along channel margins and upon various island surfaces (Atwater 1982 as cited in Stillwater Sciences 2007).

Bank revetments are common throughout this region. Based on a query of the Corps revetment database, bank revetments account for approximately two-thirds of the shoreline's linear distance. The revetments are composed of various material types and sizes, including medium to large (quarry) rock, small and large rubble, and medium to large cobbles. The majority of revetments consist of large (>20 in) rock (Stillwater Sciences 2007).

Region-Specific Description (Region 1b)

Region 1b includes the mainstem Sacramento River from Isleton in the Delta, upstream past the City of Sacramento, to the Feather River confluence (RM 80) at Verona. The region also includes the lower American River from the confluence with the Sacramento River upstream to RM 13, Natomas East Main Drain, Natomas Cross Canal, and Coon Creek Group Interceptor Unit 6. Seasonal high flows enter the adjacent Yolo Bypass from this reach of the Sacramento River via the Sacramento Bypass Weir. Tidal influence emanating from Suisun Bay extends up the Sacramento River for 80 miles to Verona, with greater tidal variations occurring downstream during low river stages in summer and fall (Stillwater Sciences 2007).

Downstream from the Feather River confluence, the Sacramento River is moderately sinuous (average sinuosity of 1.3), with the channel confined on both sides by natural levees enhanced by decades of man-made additions. The channel in this reach is of uniform width, is not able to migrate, and is typically narrower and deeper relative to the upstream reach due to scour caused by the concentration of shear forces acting against the channel bed (Brice 1977 as cited in Stillwater Sciences 2007). Channel migration is similarly limited along the lower American River (discussed in more detail below) due to the combined influence of closely spaced levees upon the river banks and flow regulation upstream by Folsom Dam (Stillwater Sciences 2007).

The natural banks and adjacent floodplains of the Sacramento and American rivers are composed of silt- to gravel-sized particles with poor to high permeability. Historically, the flow regimes caused the deposition of a gradient of coarser to finer material, and longitudinal fining directed downstream (sand to bay muds). The deposition of these alluvial soils historically accumulated to form extensive natural levees and splays along the rivers, 5–20 feet above the floodplain for as far as 10 miles from the channel (Thompson 1961 as cited in Stillwater Sciences 2007). The present day channels are flanked by fine-grained cohesive banks with erosion due to both mass failures and fluvial erosion (C. Harvey, pers. comm., 2002 as cited in Stillwater Sciences 2007).

Bank revetments currently account for two-thirds of the region-wide shorelines, which is equivalent to revetment proportions within Region 1a, based on data obtained from the SRBPP revetment database. The bank revetment composition includes medium to large (quarry) rock, rubble, and cobbles. The majority of revetments present at the erosion sites and along the banks without erosion sites is large (>20 in) rock.

Instream woody material (IWM) loading in the Sacramento River along the channel shoreline is estimated at 10% of the shoreline from RM 0–20 and 16% from RM 20–80, which is similar to other regions on the Sacramento River (see Table 3-12 in U.S. Army Corps of Engineers 2009).

Regions 2 and 3

In Region 2, above the confluence of the Feather River, constrained reaches alternate with unconstrained ones where levees are set back more than 500 feet from the high water channel edge. In Region 3, levees are set back farther, often more than 2,000 feet from the channel's edge. Since Regions 2 and 3 are somewhat less constrained, lateral migration and the formation of back channels and oxbows occur, though rarely, in these areas. In areas with natural banks, the presence of oxbows, floodplains, point bars, islands, and in-channel IWM suggests that river meander migration and erosion still occur, providing more dynamic and diverse habitat. For example, point bars formed by active channel migration provide shallow water and important aquatic invertebrate habitat. Chute cutoffs form when high flows breach and cut off a moderately sinuous bend. Eventually, the new chute cutoff channel captures the entire river flow, leaving the remnant meander bend as an oxbow that provides important backwater habitat for amphibians and aquatic invertebrates. During such channel adjustments, large woody material can be dislodged from adjacent riparian forests and deposited in the channel as IWM, creating another habitat feature. These more complex riparian features are uncommon in Region 3, and are generally absent along the more constrained sections of the Sacramento River in Regions 1a and 1b (Jones & Stokes Associates 1987; Stillwater Sciences 2007).

Region-Specific Description (Region 2)

Within Region 2, the mainstem Sacramento River flows from Colusa (RM 143), downstream of the Colusa Bypass, to the confluences with the Feather River and Sutter Bypass at Verona. The channel is generally confined by levees along the river banks except in a few locations where they are set back to provide overflow across point bars of major meander bends (Jones & Stokes Associates 1987). Contributing flows into this reach are provided by Butte Creek, the Sutter Bypass, and the Feather River (RM 80). To provide flood capacity, overflows at the Tisdale Weir (RM 119) are conveyed into the Tisdale Bypass, which routes the water into the Sutter Bypass. Upstream of the reach, floodwaters may overflow the left bank into Butte Basin via three locations near Chico Landing and through the Moulton (RM 158) and Colusa (RM 146) Weirs. At extremely high river stages, floodwaters may also overflow the right bank of the river and drain into the Colusa Basin, which eventually connects to the Sacramento River and Yolo Bypass via the Colusa Main Drain. The Feather River has a relatively large drainage basin along the Sierra foothills that receives input from several key tributaries, including Honcut Creek, the Yuba River, and the Bear River. Floodwaters may alternatively exit this reach of the Sacramento River via the Fremont Weir into the upper Yolo Bypass (Stillwater Sciences 2007).

Within Region 2, the mainstem Sacramento River is primarily a sinuous single-thread channel with uniform width, an average sinuosity of about 1.8 (Brice 1977 as cited in Stillwater Sciences 2007), and an average slope of 0.00003 to 0.0001 (one-tenth to one-half the slope of Region 3, RM 143–194). Adjacent levees and revetment are present on both sides of the channel. A narrow berm of natural substrate inside of the levees occurs in some reaches, providing some erodible substrate; however, erosion and deposition are probably greatly diminished from pre-European settlement conditions, compared to the mainstem channel within Region 3 (U.S. Fish and Wildlife Service 2001, as cited in Stillwater Sciences 2007). The adjacent floodplain and natural bank sediments are composed of alluvium consisting of clay- to gravel-sized particles. In contrast to downstream reaches located between the Feather River confluence and the Delta, floodplain sediments in Region 2 are generally much finer and cohesive. The toes of the banks also tend to be composed of fine-grained and cohesive sediments, and erosion of the banks is due to both mass failures and fluvial erosion at the coarser sediment contact above the cohesive toe material (C. Harvey, pers. comm., 2002 as cited in Stillwater Sciences 2007). Available region-wide floodplain habitats have been greatly reduced compared to historical conditions, due to the presence of channel confining levees (Stillwater Sciences 2007).

The proportion of revetment coverage within Region 2 is approximately 40%, based on data queries of the SRBPP revetment database, which is considerably less than revetment coverage of the two downstream regions (Regions 1a and 1b). Greater revetment coverage is present along the mainstem Sacramento River than along the lower Feather. Bank revetment composition includes various material types and sizes, such as medium to large rock, rubble, and cobbles. Revetments at the erosion sites and along banks without erosion sites are primarily composed of medium cobble (Stillwater Sciences 2007).

IWM input (16% for the Sacramento River; 22% for the Feather River) is only a fraction of the historical rates that occurred prior to levee construction and the clearing of floodplain forests (U.S. Fish and Wildlife Service 2001, as cited in Stillwater Sciences 2007). Riparian vegetation is limited to relict stands and individual trees that have taken root on sands deposited over bank revetment. The elimination of channel migration, chute cutoffs, and overbank deposition has reduced the availability of suitable riparian recruitment areas that are essential for developing and maintaining the riparian ecosystem and maintaining IWM recruitment to the Sacramento River over the long-term (Nanson and Beach 1977 as cited in Stillwater Sciences 2007). However, several areas north of the Feather River confluence include setback levees where some channel meander and associated habitat complexity has been restored (Stillwater Sciences 2007; U.S. Army Corps of Engineers 2009).

Region-Specific Description (Region 3)

Downstream of Chico Landing (RM 194) to Colusa (143), the Sacramento River meanders between widely spaced setback levees, which allow the river to continue its lateral migration processes within a narrow floodplain. Levees of the SRFCP begin downstream from Ord Ferry (RM 184) on the right bank and downstream from Butte City (RM 176) on the left bank. In the uppermost section of this region, overbank flows drain into the Butte Basin along the left bank at three locations: RM 191 (M & T Bend), RM 186.5 (3B's, a natural overflow), and RM 179 (Goose Lake). Floodwaters may also flow over the right bank and drain into the Colusa Basin. Just upstream of Colusa, floodwaters are diverted over Moulton Weir and Colusa Weir into the lower Butte Basin. Also included within Region

3 are lower segments of Mud, Deer, and Elder Creeks (discussed in more detail below) that join the Sacramento River at RM 193, 220, and 230, respectively (Stillwater Sciences 2007).

Within Region 3, the Sacramento River is a meandering single-thread channel bordered by setback levees. The average sinuosity is about 1.4–1.5 (Brice 1977 as cited in Stillwater Sciences) and average energy grade slopes from the Corps Hydrologic Engineering Center's River Analysis System (HEC-RAS) modeling ranged from 0.0002 to 0.0003 (U.S. Army Corps of Engineers 2004 as cited in Stillwater Sciences 2007).

Morphologic features that can be found along this reach of the Sacramento River in Region 3 include natural overflow areas, point bars, cut-banks, islands, and oxbows. The channel is bounded by natural stream channel and levee alluvium consisting of unconsolidated silt- to cobble-sized particles (Saucedo and Wagner 1992 as cited in Stillwater Sciences 2007). The median bed material size (D_{50}) is approximately 15 millimeters (WET 1988 as cited in Stillwater Sciences 2007) that provides a non-cohesive sand or gravel toe to the banks. Channel migration is limited by revetment and other bank protection structures even within the uppermost portion of this region. The highest rates of migration occur in the unconstrained sections and appear to depend upon channel cross section asymmetry and toe scour (C. Harvey, pers. comm., 2002 as cited in Stillwater Sciences 2007). Additionally, bank erosion tends to be faster in sections where riparian vegetation has been reduced (Micheli et al. 2004). Chute cutoffs that lead to oxbow formations still occur within this reach when high flows breach and cut off a sinuous river bend (Stillwater Sciences 2007).

Region 3 contains the smallest proportion of revetted banks. Revetment composition includes small to large rock, rubble, and cobble, with medium (12–20 in) rock and cobble accounting for the majority of revetment materials present in this region (Stillwater Sciences 2007).

Despite the relatively higher frequency of channel migration and, therefore, the potentially high IWM recruitment, IWM loading in this region (17%) is comparable to the two lower regions along the Sacramento River. This low level of IWM recruitment is attributable to the conversion of riparian forests to agriculture over the last 100 years (Katibah 1984 as cited in U.S. Army Corps of Engineers 2009). The bank material at the one proposed repair site on the Sacramento River within Reach 3 (SAC 157.7R) is un-revetted and composed of cohesive silt and clay near the low-flow water elevation (see Table 3-13 of U.S. Army Corps of Engineers 2009). In the vicinity of this site, the banks in straight reaches are generally un-revetted, while most outer bank areas are revetted; therefore, the river is not free to laterally migrate at historical rates (U.S. Army Corps of Engineers 2009).

Deer Creek is a relatively unregulated stream draining the high-relief southern Cascades (the Lassen Volcanic National Park area). Prior to levee construction along the lower reach, the creek historically flowed and migrated across an alluvial fan with multiple overflow channels (Deer Creek Watershed Council 1998, as cited in U.S. Army Corps of Engineers 2009). The creek has retained an active single-thread channel with ample energy to erode streambanks and to transport a wide distribution of sediment, ranging in size from silt to cobbles (Tompkins and Kondolf 2007, as cited in U.S. Army Corps of Engineers 2009). The lower reach is bordered by low-lying (<3 feet high) levees that are slightly set back from the channel margins in some areas and are constructed of locally derived silt to cobble-sized sediments that are similar in composition to the surrounding streambanks. The SRBPP revetment database indicates that the frequency of bank revetment is high; however, the database indicates that the majority of this revetment is composed of medium (6–10 inches) to small (<6 inches) cobble.

Based on the relatively small size of the material and observations made during a field visit in 2008, a significant portion of this material is likely coarse-grained alluvial deposits and not installed revetment. IWM loading in lower Deer Creek within the program area is relatively low (5%) compared to the average for the Sacramento River (17%) in Region 3 (U.S. Army Corps of Engineers 2009).

Review of Alluvial River Systems Processes

The following sections provide the geomorphic context for the various water courses in the program area, focusing on the channel network, meander belt dynamics, and bank retreat on the Sacramento River.

Channel Network Classification

Valley morphology varies going downstream in most watersheds, such as the Sacramento River watershed. Because of this variation, watersheds are divided into valley segments and channel reaches. Valley segments are distinctive sections of the valley network that possess geomorphic properties and hydrologic transport characteristics that distinguish them from adjacent reaches (Bisson and Montgomery 1996).

Valley segments can be classified into three classes based on their position within the watershed and the relative ratios of transport capacity to sediment supply (Montgomery and Buffington 1998). Headwater source areas are typically transport-limited (often due to limited channel runoff) but do offer sediment storage that is intermittently initiated under large flow events, debris flows, or other gravitational events (e.g., landslides). Transport segments are composed of morphologically resilient, supply-limited reaches (e.g., bedrock, cascade, and step-pool) that rapidly convey increased sediment inputs. Response segments consist of lower-gradient, more transport-limited depositional reaches (e.g., plane-bed, pool-riffle, and step-pool sequences) where channel adjustments occur in response to changes in sediment supply delivered from upstream.

Based on field observations and the stream classification methodology of Montgomery and Buffington (1998), the Sacramento River in the program area is an alluvial valley segment dominated by plane-bed and pool-riffle reaches. Plane-bed and pool-rifle reaches are transport-limited; therefore, the Sacramento River (and other watercourses) behave as a response segment, theoretically adjusting their bed morphology to water and/or sediment.

Review of Alluvial Meander Belt Dynamics

Deposition in river systems that are predominantly aggradational (i.e., depositional) is accomplished by both lateral and vertical accretion (build-up of sediment). In-channel, or channel-fill facies (layers or strata) tend to be dominated by lateral accretion, whereas the channel-margin facies tend to be dominated by vertical accretion. The net result of both the vertical and lateral accretion is a general fining-upward sequence in both grain size and the scale of the depositional units. However, the fining-upward sequences can be punctuated, in both the channel-fill and the channel-margin facies, by coarsening upward facies (WET 1990a).

With the channel-fill facies, coarser sediment can overlie finer sediments as a result of deposition during high flow events. The depositional ramp that is often observed at the upstream end of a point bar can introduce coarser sediments to the upper portion of the point bar surface. Similarly, chutes that cut through the upper point bar surface can cause coarse sediments to overlie finer ones (WET 1990a).

In the channel-margin facies that include natural levees and crevasse splays, large floods can cause coarse sediment deposition on top of the normally finer-grained flood basin deposits. Such deposition can result in coarsening upwards grain size trends during the progradational (flowing) phase and fining upwards trends during the abandonment (ebbing) phase. On a local scale, progradation in deltas into inter-channel lakes or abandoned channel segments can typically produce coarsening upwards deltaic sequences (WET 1990a).

Once coarser sediments are introduced to the flood basin as a result of sheetflooding or crevassing, the sediments have a high potential for being reworked by recessional flows of the same flood event or by both rising and recessional flows of subsequent flood events. Therefore, sediments deposited by one major flood event may be subsequently reworked by numerous lesser floods, giving the impression that all overbank floods cause significant overbank deposition (WET 1990a).

Bank Retreat Terminology

Gravitational forces acting on in situ bank material act in concert with hydraulic forces at the bank toe to determine rates of bank erosion, and it is the interaction of these forces that control streambank mechanics. The term ‘bank retreat’ is a collective term for all processes that act to erode streambanks in any manner, and is defined as the net linear recession of streambanks as a result of erosion and/or failure (Lawler et al. 1997). Table 4-2 contains the terms that are often used when describing bank processes. Not all bank retreat is the result of flowing water in the channel, and it is restrictive to interpret all bank retreat simply as a function of excess boundary shear stress (Lawler et al. 1997).

Table 4-2. Bank Retreat Terminology

Terminology	Definition
Bank erosion	Detachment, entrainment and removal of bank material as individual grains or aggregates by fluvial and sub-aerial processes.
Bank failure	Collapse of part or all of the bank en masse, in response to geotechnical instability processes.
Bank retreat	Net linear recession of bank as a result of erosion and/or failure.
Bank advance	The opposite of bank retreat, i.e., net linear streamwise change in bank surface position, as a result of deposition of sediment or in situ swelling of bank materials (often referred to as vertical and/or lateral accretion).
Bank erodibility	The ease with which bank material particles and aggregates can be detached, entrained and removed (normally by fluvial erosion processes).

Source: Lawler et al. 1997

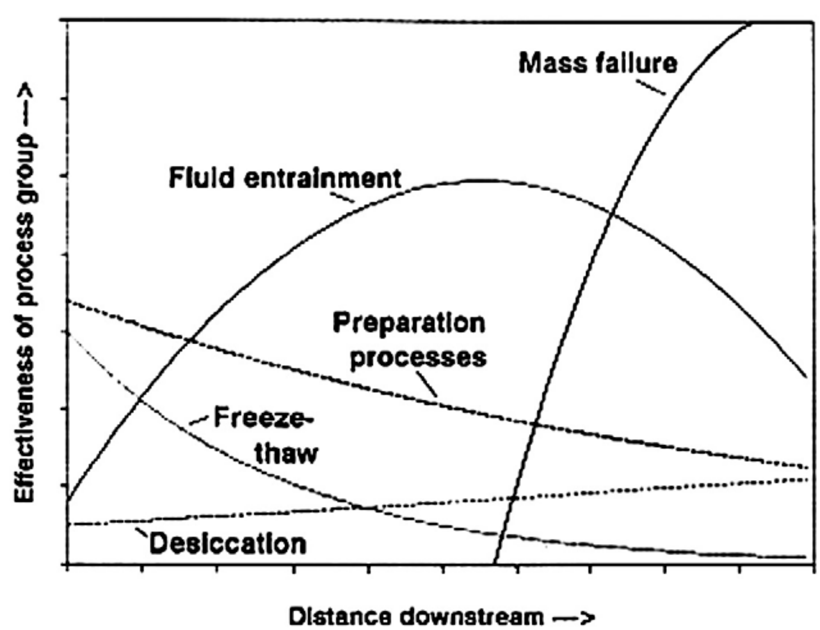
As a result, bank retreat types are grouped into three categories: weakening processes (otherwise referred to as sub-aerial preparation processes), fluvial erosion, and mass-failure processes (Lawler

1992). In brief, weakening processes are any bank or near-bank processes that act to erode or prepare banks for further erosion (Lawler 1992). Fluvial erosion is closely related to boundary shear stress, which can be loosely approximated by stream power variations, and mass failure is collapse of all or part of the bank in situ (Lawler 1995).

Fluvial erosion is probably the most dominant process eroding banks with non-cohesive banks where individual grains are dislodged or shallow slips occur along almost planar surfaces (Thorne 1982). The effectiveness of fluvial erosion against cohesive banks depends upon the moisture content and degree of pre-conditioning (i.e., weakening processes) of the material. Similar observations hold true for mass failure as well, where the susceptibility of banks to it depends on weakening processes, bank shape, structure, and material. The significance of mass failure is thought to increase as drainage basin size increases; basins greater than approximately 120 km^2 in area are more prone to mass failure processes than basins below this amount due to the increase in bank height associated with larger basins (Lawler 1995). In general, smaller basins are dominated by sub-aerial preparation processes, middle-order basins are dominated by fluvial entrainment, and larger basins (over 120 km^2) are dominated by mass failure.

Bank Retreat as a Function of Longitudinal Position in the Drainage Network

Sub-aerial preparation, fluvial, and mass-failure processes have the potential to act in accordance with each other at various points along a stream system (Hooke 1979) (Figure 4-1). For example, it is common knowledge that weakening processes, such as wetting and drying cycles, prepare banks for additional mass failure processes (Knighton 1999). The overlap of the curves in Figure 4-1 illustrates the importance of process combinations. Scale (i.e., position in the drainage network), however, is an important control of bank retreat processes, as the relative influence of these processes differs throughout the length of a channel.



Sub-aerial preparation processes dominate within the uppermost reaches of a channel; fluid entrainment processes dominate within the mid-reaches; mass failure processes dominate within the lowest reaches. All processes have the potential to act in accordance with each other. Modified from Lawler (1995).

Figure 4-1. Conceptual Model of Downstream Changes in Bank Erosion Processes

Weakening, sub-aerial processes are dominant within the uppermost reaches of a drainage basin, and these processes are predominantly controlled by soil property characteristics (Abernethy and Rutherford 1998; Lawler 1995; Lawler et al. 1997). In general, discharge and stream power are relatively low in upper reaches of stream systems, suggesting the erosive effects of flow are small in relation to the geomorphic effects of non-fluvial processes. Influential factors that control the extent and location of bank retreat in upper reaches include bank properties, such as composition, cohesion, strength, and vegetation cover (Lawler et al. 1997). Sub-aerial processes are active on streambanks throughout entire catchments, but are particularly apparent in upper reaches (Abernethy and Rutherford 1998; Lawler 1995). These weakening mechanisms include windthrow of streamside trees, damming by large woody debris, frost heave, desiccation, rainsplash, and micro-rill development. All of these processes directly influence channel and bank form and size (Abernethy and Rutherford 1998).

Vegetation is also a strong control of stability in general, and unstable areas typically have considerably less bank vegetation than stable areas (Rutherford et al. 1995). The dominant vegetation type is also important. Prevalent thought is that thick, dense vegetation common in forests provides greater roughness and resistance to fluvial entrainment through both direct interaction with growth and binding of bank material by root systems (Ryan 1992). Ryan (1992) argues, however, that grasses, which tend to colonize finer sediments, can provide more resistance than larger forest species or willows. Though the roots of grasses are not too deep, they cover a larger surface area, and. the rooting depth of grasses has the ability to stabilize the banks when bank height values are relatively low, (Rutherford et al. 1995). In addition, a study conducted by the Engineer Research and Development Center (ERDC) for the Corps found that slope stability is slightly reduced when trees are located at the crest and mid-slope locations on the land side of levees, and larger reductions in slope stability are expected as tree mass increases due to the added weight on the levee slope (Engineer Research and Development Center 2011).

Desiccation and cycles of wetting and drying promote bank instability in a similar manner. Sediment grains are mobilized and gravitational forces route the sediment into the channel. Rainsplash and micro-rill development also contribute to destabilization of streambanks. Direct rainfall has the potential to loosen sediment particles and create micro-rills (Luk 1982). The development of micro-rills has the potential to destabilize banks and increase the lateral conveyance of water into the channel (Luk 1982).

In mid-reaches (such as Regions 2 and 3 of the program area), discharge and channel slope often combine to produce peak levels of stream power and flow erositivity (Abernethy and Rutherford 1998; Lawler 1995), as shown in Figure 4-1. As a result, the dominant mechanisms of bank retreat are by direct fluid entrainment processes. Flow properties, such as discharge, boundary shear stress, and stream power, regulate the potential work available for erosion (Graf 1983). Since discharge and channel slope combine in the mid-reaches of a channel to produce erosive flows, the stability of banks here is largely determined by bank characteristics (Annandale 1995; Annandale and Parkhill 1995). Bank properties, especially the presence or absence of stabilizing vegetation are important. (Rutherford et al. 1995). The resultant forms of bank failure in the mid-reaches depend on the sedimentological nature of the streambanks (Lawler 1992), and are discussed below along with bank failure forms in the lowest reaches of stream channels.

Where it is a result of fluvial erosion, bank retreat is well predicted by stream power and its associated variables (Annandale and Parkhill 1995). In mid-reaches, valley and channel slope, valley width, and bend morphology are all influential in controlling bank retreat (Lawler et al. 1997; Magilligan 1992; Miller 1995). In general, higher unit stream power values are associated with higher channel slopes and lower valley widths (Graf 1983). Other studies have also shown that valley morphology exerts a strong control over flow patterns; these patterns, in turn, influence the amount of erosion performed (Baker and Costa 1987; Miller 1990; Miller 1995). When valley width and channel slope vary as a function of lithology, an irregular pattern of downstream erosion rates as a result of variable flood power will emerge (Magilligan 1992). Variations in valley morphology are most important in influencing bank instability in middle and lower reaches of a stream system, where there is usually more available discharge and stream power (Graf 1983).

Bank retreat increases at bends in the channel as well. Hooke (1980) concludes that important bank retreat is more likely to occur at bends in the channel where flow is deflected and stream power and shear stress are increased. Schumm (1977) and Thorne and Osman (1987) also suggest that unstable areas commonly occur at bends in the channel, and stable areas are more often found in straighter reaches. Whether the adjacent geomorphic surface is a floodplain, a steep, colluvial valley, or a terrace, bank height and the active channel width also importantly influence unit stream power and instability. In other words, the relationship between a channel and its floodplain is important in determining unit stream power, and therefore bank instability. Brizga and Finlayson (1990) state that active channels within incised areas surrounded by terraces have importantly high stream power values during flow events. Conversely, rivers which flood over their banks onto floodplains have lower stream power.

While variations in unit stream power and its associated variables dominate bank retreat within the mid-reaches of a channel, they can also be important in the lowest reaches (such as Regions 1a and 1b on the program area) (Lawler 1995). Streambanks in lower reaches of streams, however, are usually typified by bank materials that are more resistant to fluvial action and have higher cohesion than upstream banks (Lawler 1992). Lawler (1992) suggests that, where there is a gradual downstream increase in channel size, there should be a point where bank height exceeds some critical value for the boundary material and mass failure assumes dominance in the erosion process. Simon et al. (2000) also suggest that the presence of overly steep banks has the potential to destabilize banks. Other studies suggest that unstable, eroding banks typically have high bank angles and high bank heights (Thorne 1982; Thorne and Tovey 1981). Thus, the primary mechanism of bank retreat in the lowest reaches of stream systems is bank failure, rather than fluvial erosion. Influential factors in these mass failure processes include the height, angle, composition, stratigraphy, and moisture content of the banks (Lawler et al. 1997).

Erosion Mechanisms in the Program Area

Bank material is generally removed in proportion to streamflow along the upper Sacramento River (U.S. Army Corps of Engineers 1981), but wind and boat-wave erosion may become dominant along the lower river and sloughs (Limerinos and Smith 1975 as cited in Jones & Stokes Associates 1987). Both brief, very large runoff events and sustained high-water periods can remove substantial material from the river's banks. The initiator of floodflow bank erosion can be the tractive force of floodflow itself, as magnified by channel obstructions and reduced capacity, or the collapse of saturated bank materials after rapid reduction of the water surface elevation. Erosion below Sacramento is often initiated by the removal of bank vegetation at low and moderate water shoreline from repeated wind wave or boat wake attack. Headward erosion of overbank inflows also initiates bank erosion (Jones & Stokes Associates 1987).

Within the program area, the Sacramento River passes from a continuously eroding and depositing, meandering stream at RM 194, with moderate flow velocities, to a series of low-velocity distributary channels in the Delta, closely bordered by levees. Thus, erosional regimes differ between regions within the program area (Jones & Stokes Associates 1987).

Regions 1a and 1b

Below Sacramento, relatively low velocity floodflows (<6 feet per second [fps]) predominate (Veres pers. comm. as cited in Jones & Stokes Associates 1987). Channels of the main river and sloughs are relatively straight, as the river flow is distributed in the network of Delta channels. These channels are bordered by relatively low and narrow “berms,” or remnant floodplains, enclosed by levees closely paralleling them.

Bank erosion is gradually removing the berms throughout most of the lower regions, and in many places erosion has completely removed the berm and encroached on the levee itself. The primary initiator of this streambank erosion appears to be boat wake and wind wave attack of the bank vegetation and soils at the low flow water surface elevation. Once vegetation is removed, this wave action, or sloughing of saturated columns of bank materials following reductions in the water surface elevation, continues to undermine the banks. Floodflows exacerbate the situation by removing exposed bank materials and scouring additional material (Jones & Stokes Associates 1987).

The relationship of boat wake, wind wave, and floodflow erosion in the Georgiana Slough was evaluated by the U. S. Geological Survey (Limerinos and Smith 1975 as cited in Jones & Stokes Associates 1987). Although the proportion of observed erosion due to each of these causes on an annual basis could not be accurately estimated, it was observed that fully one-half of the bank erosion occurred during low flow months when floodflows did not occur. Boat wake erosion was identified as a significant factor in bank erosion along the Delta waterways (Jones & Stokes Associates 1987).

The wavewash attack is aided by a tidal influence, extending to Sacramento. Diurnally, the low water surface rises and falls, causing the wavewash zone to fluctuate accordingly (Jones & Stokes Associates 1987).

Flood stage berm or levee erosion, above erosion initiated at the low flow water surface elevation, is apparently not widespread in Delta channels. At some sites, floodwaters have scoured the berm surface or the levee slope above the berm, but for the most part berm vegetation has successfully resisted floodflows. At riprapped sites, erosion above the revetment has sometimes occurred, but usually where compacted embankment was placed above the rock and revegetation was not secure (Jones & Stokes Associates 1987).

A more recent study performed by Northwest Hydraulic Consultants (2007) supports the statements above regarding the relationship of boat wake, wind wave, and floodflow erosion, and indicates the four most common bank failure mechanisms along Sacramento River in this region.

- Wave erosion, particularly from waves generated by recreational boat traffic on the Sacramento River. The erosion from boat traffic occurs during the summer and fall, when water levels are near their annual minima, and results in wave cut benches, steep eroding banks, and slow bank retreat. Erosion from wind-generated waves also occurs on the upper levee slopes during high flow events.
- Failures or slides on the berm, possibly as a result of over-steepening, saturation, toe scour, or other factors.
- Levee encroachment from scour at the toe of the bank where banks are steep below the water level and erosion has progressed into the 3:1 projected waterside slope of the levee template.
- Tree roots can bind and strengthen soils in some cases, but undermined or undercut trees that result in over-steepened and eroded sections on the bank that eventually may fall over, could result in loss of bank or levee and further erosion as flows accelerate around the root ball.

These observations are consistent with previous reports on bank erosion along the Sacramento River in this region (see Northwest Hydraulic Consultants 2005, 2006; U.S. Army Corps of Engineers 2006).

As discussed earlier, much of the Sacramento River is protected by riprap revetment. These revetments are in reasonable repair and have withstood floods for 30 or 40 years and have been assumed to continue to provide erosion protection, given adequate maintenance. As such, they have a low risk of failure and a low priority for treatment. However, the rock placed on these slopes has been damaged by wave erosion, it is often smaller than currently recommended for protection from boat wakes and waves (U.S. Army Corps of Engineers 2006), and it is not known whether adequate toe rock was installed to protect against scour.

Region 2

As in the lower regions, levees border the Sacramento River, except where they are set back across the base of a few major meander loops. Even here, the stream is no longer free to migrate. Berms in this region are generally present, and are wider and higher above the channel than in the lower regions (Jones & Stokes Associates 1987).

Although the channel no longer migrates, bank erosion continues from impingement of the primary flow energy at channel bends; this process is described for the upper region to follow. Boat wake and windwave erosion are also sometimes operative in this region, as just described for the lower regions. The erosional regime is most similar to the upper region, but in this region is a composite of both the upstream and downstream environments (Jones & Stokes Associates 1987).

Region 3

In the uppermost region, the Sacramento River is a single-thread meandering channel migrating through alluvial deposits until constrained by setback levees. Floodflows are commonly of higher velocity (>5 fps), and significant flow energy is constantly impinging on banks at the outsides of meander bends during all levels of flow and at the inside of bends during floodflow (Jones & Stokes Associates 1987).

Because levees are set back, berms in the upper reaches are generally wide. The berms also tend to be at higher elevation above the channel, so that eroded, near-vertical banks more than 15 feet in height are common. In the uppermost reach of this region (above RM 176 in the east bank and RM 184 on the west bank), levees have not been constructed; floodflows overtopping the high banks drain easterly to Butte Basin (Jones & Stokes Associates 1987).

Bank erosion in this region is almost entirely due to streamflow. As the primary flow energy sweeps past banks on the outside of river banks, a secondary, helicoidal (spiraling) flow deepens the channel at the outside edge. Thus, the bank is undermined, and the larger, local velocities attack the bank materials (Odgaard and Kennedy 1983 as cited in Jones & Stokes Associates 1987). Erosion and sediment transport increase with flow velocity, which in turn increases with stream discharge. Flood flow scour of berm surfaces and levees beyond the channel banks also occasionally occurs (Jones & Stokes Associates 1987).

Although levees are typically set back from the river in the upper region, stream meandering occasionally brings active bank erosion toward the toes of the levees, thus requiring bank protection work under the proposed program. Other bank protection work has been proposed where the channel is migrating in proximity to flood relief structures and weirs. These structures are intended to allow overflow of floodwaters into basins and bypasses when streamflow exceeds the downstream capacity of the leveed river. To maintain the proper “flow split” at these locations, some channel stabilization has been pursued (Woodward-Clyde Consultants 1986). However, subsequent studies have concluded that bank protection is not needed in certain areas (M&T Flood Relief Structure at RM 191, a natural overflow area referred to as the 3-B’s overflow at RM 186.5, and the Goose Lake Flood Relief Structure at RM 179) in order to maintain the flow split because other factors are equally important in controlling planform changes, and revetment of channel bends with a low ratio of bend radius of curvature to channel width does not prevent cutoffs (Ayres Associates 1997).

Projected Incision Estimates (Regions 1a and 1b Only)

Northwest Hydraulic Consultants (2007) examined the thalweg profiles for 1908, 1933, and 1997 for bed elevation trends by drawing smoothed upper and lower envelopes for each survey year, for the reach extending from Verona (RM 79) to Freeport (RM 46). The analysis indicated the following:

- Over the greater part of the reach that extends downstream from RM 79 (Verona Gage) to RM 46 (Freeport Gage), thalweg levels dropped by an average of about 5 ft. over the period 1908–33. This is equivalent to an average of about 0.2 ft./year.
- In the period 1933–1997, levels over the lower two-thirds of the same reach appear to have fallen on average by another 4 ft. This is equivalent to an average of about 0.06 ft./year.
- When these assumed rates of incision are plotted as block averages against time and fitted by a smooth descending curve, they suggest a current incision rate of around 0.02 to 0.03 ft./year, probably declining to zero in less than 50 years. Even if the future rate is assumed to average 0.02 ft./year over a period of 50 years, the total future incision would amount to only 1 ft.

- Information from various sources indicates that the low-water surface profile falls from about + 6 ft. National Geodetic Vertical Datum of 1929 at Verona to +2 ft. at Freeport. These elevations yield average low-water gradients at mean tide level of about 0.12 ft./mile (0.023 m/km) from Verona to Freeport, and 0.043 ft./mile (0.008 m/km) from Freeport to the Delta. These gradients are extremely flat in general terms, and further significant lowering of the quoted low-water levels is unlikely to occur.
- In brief, given the apparent rates of incision in the second half of the 20th century and present low-water elevations, further significant incision of the Sacramento River downstream of Verona is unlikely to occur. Any further incision could hardly exceed 1 foot or so, an amount that is negligible compared to potential river-bed scour resulting from major floods.

Erosion Sites Summary

As described in Chapter 2, Project Description, the Corps (Sacramento District) and the California Department of Water Resources (DWR), conduct an annual field reconnaissance review of the SRFCP (Ayres Associates 2008). Specific criteria are used to identify erosion sites within the system as described in Ayres Associates (2008). In most cases the criteria are based on bank and levee conditions that are threatening the function of the flood control system. An erosion site is defined as:

> A site that is at risk of erosion during floods and/or normal flow conditions; the term “critical” is used to indicate erosion sites that are an imminent threat to the integrity of the flood control system and of the highest priority for repair.

Ayres Associates (2008) identified 154 erosion sites, of which the Corps selected 107 sites for further evaluation and design of bank protection in the Final Alternatives Report—80,000 LF (107 Sites), Sacramento River Bank Protection prepared by Kleinfelder-Geomatrix (2009).

As previously described in Chapter 1, Introduction, 106 of these sites along the Sacramento River and its tributaries have been carried forward for programmatic analysis in this EIS/EIR and constitute a representative sample of the sites to eventually be treated.

Final Alternatives Report

The 107 erosion sites evaluated in the Final Alternatives Report (Kleinfelder-Geomatrix 2009) include a total of about 80,000 linear feet. The physical upstream and downstream boundaries of each site were extracted from the Sacramento Riverbank Protection Project Database (SRBPPD), which is maintained by the Corps, in the form of a digital shapefile for each site. The digital measurements of the length for each site from upstream boundary to downstream boundary along the shoreline of the levee amount to about 85,000 linear feet. Each site, identified by River Name ID, River Mile (RM) or Levee Mile (LM), and placement on the left or right bank (relative to facing the downstream direction) is presented in Table 1.0-1 of the Final Alternatives Report (Kleinfelder-Geomatrix 2009). Also included in this table are the lengths of each erosion site as given by: a) the task order description, b) the SRBPPD shapefiles, and c) the recommended adjusted repair length. The evaluated alternatives, recommended repair alternative, and budget-level construction cost estimate for the recommended repair alternative for each site are also provided in Table 1.0-1 of the Final Alternatives Report.

The survey of the 107 sites was based on visual inspection only, from both the landside and the waterside. Based on the best professional judgment of the Kleinfelder-Geomatrix team, measures were selected from the Corps-proposed four types of bank protection measures. Other bank protection measures, such as setback levees, biotechnical fixes, or back-side levee construction, also were considered, as appropriate.

The scope of the alternatives survey for each site included the following information.

- A brief description of the existing conditions.
- Photos of each site, including aerial photography showing the site extent.
- A discussion of the different alternatives, and the basis for selecting the preferred alternative.
- A conceptual cross-section for repair.
- Preliminary cost estimates using current unit prices.
- A summary of a survey of potential affected landowners to determine their willingness to sell their land for project purposes.
- A summary of comments received from the California Department of Fish and Wildlife, DWR, National Marine Fisheries Service, and the United States Fish and Wildlife Service concerning the site and/or design alternative.

Refer to Kleinfelder-Geomatrix (2009) for a complete description of the 107 erosion sites within the program area.

Flooding

Levees along the Sacramento River and other waterways in the program area provide flood control for numerous rural residences and farms, towns, and cities, as well as conveyance for waters from upstream to the Delta. High winter flows can stress levees and berms. Longer flood durations can contribute to levee seepage and potentially structural levee failure. Flood water surface elevations also can exceed levee heights and cause overtopping and partially controlled flooding of the protected areas behind the levee. Overtopped levees may maintain structural integrity and would not be considered failed levees. However, the erosive forces that occur during overtopping eventually may cause a structural failure and uncontrolled flooding in the protected areas behind the levee. To maintain the integrity of the flood control system, locations with the potential for failure have been and are being identified and remedied.

The intent of the proposed program is not to increase the current level of flood protection. The proposed program is remedial in nature and is intended to correct and address changed conditions, including reservoir construction and the removal of hydraulic mining debris, which no longer require levees to be close to channels. All bank protection/levee construction or modification conducted as part of the proposed program of improvements would be designed based on the results of detailed geotechnical engineering studies and would be required to comply with standard engineering practices for levee design. The CVFPB standards are the primary state standards applicable to SRBPP levee improvements; these are stated in Title 23, Division 1, Article 8, Sections 111–137 of the California Code of Regulations. The CVFPB standards direct that levee design and construction be in accordance with Engineering Design and Construction of Levees, the primary federal standard applicable to levee improvements, and other applicable Corps standards. Because the design and construction of flood control improvements and maintenance of the facilities must comply with the regulatory standards of these agencies, it is assumed that the design and construction of all modifications to the flood control system under the proposed program would meet or exceed applicable design standards for maintaining or exceeding existing levee height requirements to protect persons and property from flooding.

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state and local laws, regulations, and policies that pertain to hydrology, hydraulics, geomorphic conditions, and flood control issues within the program area. The pertinent laws, regulations, and policies are listed below.

- Federal:
  - National Environmental Policy Act
  - Clean Water Act
  - National Flood Insurance Program
  - U.S. Army Corps of Engineers Levee Design Criteria
  - Executive Order 11988 (Floodplain Management)
  - Code of Federal Regulations, Title 40, Part 131, Water Quality Standards
  - Flood Control and Coastal Emergency Act (Public Law 84-99)
- State:
  - California Environmental Quality Act
  - Fish and Game Code Section 1602: Streambed Alteration Agreements
  - California Code of Regulations, Title 23
  - Central Valley Flood Protection Board guidance
  - Delta Protection Act of 1992
  - Safe, Clean, Reliable Water Supply Act
- Local:
  - American River Parkway Plan
  - Butte County General Plan
  - Butte County Multi-Jurisdictional All-Hazard Pre-Disaster Mitigation Plan
  - Butte County Flood Mitigation Plan
  - Colusa County General Plan
  - Glenn County General Plan
  - Placer County General Plan
  - Sacramento County General Plan

- Solano County General Plan
- Sutter County General Plan
- Tehama County General Plan
- Yolo County General Plan
- Yuba County General Plan

Determination of Effects

This section lists the thresholds for significance used to assess proposed program effects on flood control and geomorphology. In this joint federal and state EIS/EIR, reference to "significant effects" is made to fulfill the requirements under CEQA and NEPA (40 Code of Federal Regulations Section 1502.16). Regardless of level of significance, all potentially significant environmental effects have been analyzed and are discussed.

Assessment Methods

Assessment of environmental effects associated with hydrology, hydraulics, geomorphology, and flood control issues has been accomplished in three ways.

- An evaluation of existing conditions of program area levees and projected incision and scour estimates in the adjacent waterways.
- Qualitative assessments of sedimentation/scour potential based on existing federal and state channel hydraulic design standards and guidelines.
- Determination of effects through professional judgment.

Significance Criteria

The criteria used for determining the significance of an effect on hydrology, hydraulics, geomorphology, and flood control are primarily based on Appendix G of the State CEQA Guidelines (Environmental Checklist) and professional standards and practices. The significance criteria have been modified as appropriate to be specific to the proposed program. All bank protection/levee construction or modification conducted as part of the proposed program of improvements would be designed based on the results of detailed geotechnical engineering studies and would be required to comply with standard engineering practices for levee design. The intent of the proposed program is not to increase the current level of flood protection. .Effects on hydrologic or geomorphic conditions may be considered significant if implementation of an alternative would:

- Substantially alter the existing drainage pattern of the site or area, including the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on or off site.

An effect on the levee system is considered significant if an alternative would substantially increase any of the following:

- Bank erosion or bed scour

- Sediment deposition.

In addition, an effect on the levee system is considered significant if an alternative would substantially decrease any of the following:

- Levee stability.
- Current level of levee slope protection.
- Channel conveyance capacity.

Finally, an effect to the geomorphic regime is considered significant if an alternative would result in the following:

- Increase in channel and/or bank erosion.
- Substantial alteration in existing migration processes.
- Changes in the local hydraulics, including shear stress.
- Loss of sediment supply.
- Loss of IWM loading and recruitment.

Effects and Mitigation Measures

Alternative 1–No Action

Under Alternative 1, no activities would be conducted to halt erosion and protect the levees in the program area and flood control and geomorphic regimes would not change relative to existing conditions. However, the streambanks in the program area would remain susceptible to bank failure, increasing the risk of levee failure and subsequent flooding in the surrounding areas.

Eventually, emergency repair measures would likely need to be implemented to protect the levee system from failing. Levee repairs under these circumstances would likely involve the placement of bare rock revetment without the advantages of contouring riparian benches with IWM embedded in the rock, minimal protection and replanting of the riparian forest, and rock being placed without the advantage of planned or coordinated hydraulic modeling efforts to design and guide the installation in a manner that minimizes velocity and water surface elevation differentials between pre- and post-project scenarios. These steps may adequately protect the flood control system but could have substantial significant effects on many other resources.

Alternative 2A–Low Maintenance

Effect FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment

Alternative 2A entails installing revetment along the levee slope and streambank. No significant flood control or geomorphic–related effects are associated with this bank protection measure, as it would provide material with a greater resistance to erosion, thus helping to decrease relative erosion amounts. Additionally, the roughness associated with the rock slope protection would counter the increased shear stresses of larger flow events that otherwise would increase erosion of the levee fills.

Alternative 2A would not result in any long-term changes to the overall existing drainage pattern of the erosion repair site. However, unless the proposed repairs can be transitioned into existing revetment geometry, this alternative could indirectly affect the existing potential for levee erosion upstream or downstream of a particular erosion site. With implementation of Mitigation Measure FCGEOM-MM-1, this indirect effect would be less than significant.

While the arrest of levee/bank erosion at the repair sites is one of the intended consequences of this alternative, the results could have some geomorphic implications. The new bank revetment would contribute to fixing the channel planform position by limiting lateral channel migration at the erosion repair sites; the rivers are already similarly constrained by levees and revetment in other locations. In many cases, proposed bank repairs would not alter the overall geomorphic trajectory of the reaches affected by the proposed action. Within Regions 1a, 1b, and 2 along the Sacramento River (RM 0–143), where existing bank revetment is well documented, the planform position of the Sacramento River is essentially fixed in place, with limited opportunity for lateral migration or sediment recruitment from channel banks irrespective of the proposed action. Upstream in Region 3 where the Sacramento River laterally migrates more freely, the new bank revetments would contribute to fixing the channel planform position by limiting lateral channel migration at the erosion repair sites to a greater degree than downstream.

Overall, direct effects related to arrest of bank erosion are considered to be less than significant because of the generally fixed nature of the river's planform. Implementation of Mitigation Measure FCGEOM-MM-1 would ensure that any indirect effects to upstream and downstream areas would be less than significant.

Mitigation Measure FCGEOM-MM-1: Conduct Site-Specific Studies at Levee Repair Sites and Minimize Changes in Local Hydraulic Conditions through Project Design

The agencies implementing program components and agencies' primary contractors for engineering design and construction will ensure that the following measures are implemented to avoid significant effects associated with changes in local hydraulics and shear stress.

During project design, a project engineer and a geomorphologist will determine if site-specific studies are warranted to avoid significant effects associated with changes in local hydraulics and shear stress. Design specifications will be developed that minimize changes in pre- and post-project implementation velocity fields and water surface elevations. Depending on the scale of the project repair, either professional judgment or hydraulic modeling that computes either steady state 1-dimensional (HEC-RAS) or 2-dimensional flow (SMS/RMA2) analysis for the 100-year flow rate for each bank repair site will be performed. If modeling is performed, design specifications will be developed based on the model results that minimize changes in pre- and post-project implementation velocity fields and water surface elevations. The maximum allowable tolerance for change in water surface elevation for a 100-year flood event will be developed based on existing federal and state channel hydraulic design standards and guidelines between pre-and post-project model scenarios. Velocity differentials between pre- and post-project scenarios will not be allowed to exceed levels that would cause bank erosion (evaluated based on the composition of nearby streambanks). Designs will also be adjusted to limit bed scour.

Effect FCGEOM-2: Increase in Levee Slope Stability

The flatter slopes associated with this alternative (3:1 [H:V] on the waterside and 2:1 on the landward side) would provide more slope stability for the levee. Effects related to increase in levee slope stability are considered to be beneficial. No mitigation is required.

Effect FCGEOM-3: Decrease in Instream Woody Material Recruitment

Existing shrubby vegetation and trees on the waterside slope and on the natural bank within 15 feet of the waterside toe would not be in compliance with Corps's Guidelines for Landscape Planting and Vegetation Management at Floodwalls, Levees, Embankment Dams, and Appurtenant Structures and would be removed. Vegetation removal would occur on the waterside slope of the levee section that receives bank protection.

Consequently, the proposed construction-related activities would result in loss of the riparian vegetation communities at the erosion repair sites and thus to downstream reaches. The presence of in-channel IWM provides more geomorphic complexity and habitat diversity at the erosion repair sites and downstream. These onsite direct and downstream indirect effects related to decrease in IWM recruitment are considered to be significant. Mitigation Measure FISH-MM-2: Compensate for Loss of Fish Habitat, and Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat would reduce this effect to a level that is less than significant by providing more geomorphic complexity and habitat diversity.

Effect FCGEOM-4: Changes in Local Hydraulics and Shear Stress

The proposed erosion site repairs would change the channel geometry at the erosion sites and alter the local hydraulics (i.e., flow velocity fields and water surface elevations). The erosion site repairs under this alternative include placing additional revetment onto the waterside of the existing levees, which would build out the levee prism and reduce the channel cross-sectional area. The physical response to a reduction in cross-sectional area for a given discharge is for flow velocity to increase and/or water stage to rise. Both effects increase boundary shear stress, and an alluvial river channel would typically respond by laterally eroding and/or vertically incising to a new quasi-equilibrium channel that would transport the same amount of sediment at a given discharge as the original channel.

Additionally, for many of the proposed repair sites, limited opportunity exists for the channel to laterally adjust due to extensive revetment in the vicinity of the sites, which would imply that vertical erosion may result due to the proposed activities.

However, the roughness associated with the rock slope protection would counter the increased shear stresses of larger flow events that otherwise would increase erosion of the levee fills. Furthermore, potential erosion effects from changes in river hydraulics would likely be localized and not reach-wide gradient or channel width adjustments (which could be considered indirect effects).

Overall, this effect would be significant. With Implementation of Mitigation Measure FCGEOM-MM-1, this effect would be less than significant.

Alternative 3A–Maximize Meander Zone (Environmentally Superior Alternative)

Alternative 3A consists almost entirely of setback levees and adjacent levees, with four of the representative sites assessed in this programmatic analysis requiring revetment. Effects from setback levees and revetment at the four sites are discussed below. There would be little to no effects on flood control and geomorphology associated with the construction of adjacent levees, because the existing levee would remain in place and erosion would be allowed to continue. Recruitment of IWM, to the extent it is available at the site, would also continue.

Effect FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment

Alternative 3A consists almost entirely of setback and adjacent levees. However, of the representative sites selected for analysis in this programmatic document, four of the sites (totaling over 10,000 linear feet) would require application of Bank Protection Measure 2 (Bank Fill Stone Protection with No On-Site Woody Vegetation). At these sites, Effect FCGEOM-1 as described under Alternative 2A would apply. Overall, direct effects related to arrest of bank erosion are considered to be less than significant because of the generally fixed nature of the river's planform. Implementation of Mitigation Measure FCGEOM-MM-1 would ensure that any indirect effects to upstream and downstream areas would be less than significant.

Effect FCGEOM-2: Increase in Levee Slope Stability

While the structural changes are substantially different, the effects on flood control and geomorphology under Alternative 3A would be similar to Effect FCGEOM-2 described under Alternative 2A in that levee slope stability would be improved. Effects related to increase in levee slope stability are considered to be beneficial. No mitigation is required.

Effect FCGEOM-3: Decrease in Instream Woody Material Recruitment

Alternative 3A consists almost entirely of setback and adjacent levees. However, of the representative sites selected for analysis in this programmatic document, four of the sites (totaling over 10,000 linear feet) would require application of Bank Protection Measure 2 (Bank Fill Stone Protection with No On-Site Woody Vegetation). At these sites, Effect FCGEOM-3 as described under Alternative 2A would apply. The onsite direct and downstream indirect effects related to decrease in IWM recruitment are considered to be significant. Mitigation Measure FISH-MM-2: Compensate for Loss of Fish Habitat and Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat would reduce this effect to a level that is less than significant by providing more geomorphic complexity and habitat diversity.

Effect FCGEOM-4: Changes in Local Hydraulics and Shear Stress

At the four sites requiring application of Bank Protection Measure 2 under Alternative 3A, the changes in local hydraulics and shear stress would be similar to those described above for

Alternative 2A. Overall, this effect would be considered significant. With Implementation of Mitigation Measure FCGEOM-MM-1, this effect would be reduced to a less than significant level.

Effect FCGEOM-5: Minimization of Stream Energy and Associated Floodplain Scour and/or Deposition

A setback levee is an entirely new section of levee constructed at some distance landside of the existing levee. For restoring geomorphic function to a river segment, a setback levee provides several benefits. A setback levee would provide more floodplain capacity. This increase in floodplain capacity would decrease the stream energy associated with higher flows on the river by allowing the river to access its floodplain under these higher flows. An increase in floodplain capacity represents an increase in hydraulic capacity, a beneficial effect from a flood control standpoint.

Because of the increased conveyance area associated with the setback conditions, the magnitude of boundary shears within the reach would be generally slightly less than that of the existing condition, but would remain adequate to transport the input sediment load, similar to the existing condition. Indirect changes upstream and downstream of the project reach are anticipated to be negligible.

Although variability in the magnitude of both floodplain scour and deposition associated with high flows is unknown, it is assumed that deposition would be the predominant geomorphic process associated with a setback levee because of the associated decrease in stream energy. Any amount of scour most likely would be limited to the upstream end. It is assumed that bank erosion on the newly reshaped bank (i.e., former levee surface) on the waterside would remain stable because features associated with this treatment would be engineered to withstand the forces of erosion by flowing water. Associated deposition of fine sediments is considered a beneficial effect as deposition would encourage natural recruitment of woody material and increase the habitat diversity on the floodplain. Floodplain trees would eventually serve as an IWM source as the stream continued its gradual migration into the floodplain. Furthermore, deposition of a significant amount of fine sediment in the channel is considered unlikely because the channel-forming flow regime would be unchanged.

Additionally, the existing bank and levee erosion adjacent to the stream channel would be allowed to continue at present rates, thereby providing for sediment and IWM recruitment.

The proposed levee setbacks may affect the location and size of in-stream depositional features (i.e., natural bar features which support mature riparian vegetation) if project construction activities disrupt these features. Mitigation Measure FCGEOM-MM-1 would reduce this indirect effect to a less-than-significant level.

Effect FCGEOM-6: Substantially Alter the Existing Drainage Pattern of the Site or Area

This alternative would involve earthwork on the landward side of the levee. The new material on the landside could cross drainage infrastructure maintained by local landowners or local agencies in some locations or alter surface runoff patterns. Because interference with drainage could cause or exacerbate local flooding, this effect would be significant.

Mitigation Measure FCGEOM-MM-2: Coordinate with Owners and Operators, Prepare Drainage Studies as Needed, and Remediate Effects through Project Design

The agencies implementing program components and their primary contractors for engineering design and construction will ensure that the following measures are implemented to avoid, minimize, and rectify significant effects associated with disruption of local drainage systems.

During project design, project engineers will coordinate with owners and operators of local drainage systems and landowners served by the systems to evaluate pre- and post-project drainage needs and design features to remediate any program-related substantial drainage disruption or alteration in runoff that would increase the potential for local flooding. If substantial alteration of runoff patterns or disruption of a local drainage system could result from a project feature, a drainage study will be prepared as part of project design. The study will consider the design flows of any existing facilities that would be crossed by project features and develop appropriate plans for relocation or other modification of these facilities and construction of new facilities, as needed, to ensure equivalent functioning of the system during and after construction. If no drainage facilities (e.g., ditches, canals) would be affected, but project features would have a substantial significant effect on runoff amounts and/or patterns, new drainage systems will be included in the design of project improvements to ensure that the project would not result in new or increased local flooding. Any necessary features to remediate project-induced drainage problems will be constructed before the project is completed or as part of the project, depending on site-specific conditions. Implementation of this mitigation measure will avoid, minimize, or rectify any significant effects.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment

This effect would be the same as under Alternative 2A. Overall, direct effects related to arrest of bank erosion are considered to be less than significant because of the generally fixed nature of the river's planform. With implementation of Mitigation Measure FCGEOM-MM-1, indirect effects would be less than significant.

Effect FCGEOM-2: Increase in Levee Slope Stability

This effect would be the same as under Alternative 2A.

Effect FCGEOM-3: Decrease in Instream Woody Material Recruitment

The low riparian bench with revegetation and IWM above the summer/fall waterline design entails installing revetment along the levee toe and upper bank, as well as a rock/soil bench to support riparian vegetation and provide a place to anchor IWM. Treatment of existing vegetation would be similar to Alternative 2A. Consequently, the proposed construction-related activities would result in loss and replacement of the riparian vegetation communities at the erosion repair sites and downstream areas. As described above, the presence of in-channel IWM provides more geomorphic complexity and habitat diversity.

However, as part of the project design, riparian vegetation would be planted to anchor IWM. The effects on the riparian vegetation would likely persist for 5–10 years before newly planted vegetation reaches sufficient height to provide shaded riverine and riparian habitat. IWM recruitment to the rivers would be affected during the reestablishment of the woody vegetation. Bank stabilization would result in the arrest of bank erosion and channel migration; thus, the primary mechanisms for natural IWM recruitment in the future would be wind-throw and tree mortality. Recruitment from newly planted trees would not occur until trees reach maturity and begin to senesce, about 25–50 years after planting.

To reduce the effects related to the loss of existing IWM during construction and tree reestablishment, the proposed construction activities include installation of IWM above the summer/fall waterline, which would significantly increase short-term IWM loading levels from current levels. However, the losses in IWM recruitment for the 25–50 years following construction would be a significant effect. Implementation of Mitigation Measure FISH-MM-2: Compensate for Loss of Fish Habitat and Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat would reduce this effect to a level that is less than significant.

Effect FCGEOM-4: Changes in Local Hydraulics and Shear Stress

This effect would be similar to that described under Alternative 2A, but the effects would likely be of a greater magnitude as a result of riparian benches with vegetation extending into the channel. Regardless, any changes in hydraulics and shear stress would require analysis and consideration of results. With Implementation of Mitigation Measure FCGEOM-MM-1, this effect would be less than significant.

Effect FCGEOM-5: Minimization of Stream Energy and Associated Floodplain Scour and/or Deposition

This effect would be similar in type as Alternative 3A, but at a lesser magnitude because fewer setback levees would be constructed under Alternative 4A.

Effect FCGEOM-6: Substantially Alter the Existing Drainage Pattern of the Site or Area

This effect would be similar to Alternative 3A, but at a lesser magnitude because less landside work would be required, which would reduce the potential to interfere with drainage infrastructure. With Implementation of Mitigation Measure FCGEOM-MM-2, this effect would be less than significant.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment

This effect would be the same as under Alternative 2A. Overall, direct effects related to arrest of bank erosion are considered to be less than significant because of the generally fixed nature of the river's planform. With implementation of Mitigation Measure FCGEOM-MM-1, indirect effects would be less than significant.

Effect FCGEOM-2: Increase in Levee Slope Stability

This effect would be the same as under Alternative 2A.

Effect FCGEOM-3: Decrease in Instream Woody Material Recruitment

This effect would be the same as under Alternative 4A.

Effect FCGEOM-4: Changes in Local Hydraulics and Shear Stress

This effect would be the same as under Alternative 2A. With implementation of Mitigation Measure FCGEOM-MM-1, this effect would be less than significant.

Effect FCGEOM-5: Minimization of Stream Energy and Associated Floodplain Scour and/or Deposition

This effect would be similar in type as Alternative 3A, but at a lesser magnitude because fewer setback levees would be constructed under Alternative 5A.

Effect FCGEOM-6: Substantially Alter the Existing Drainage Pattern of the Site or Area

This effect would be similar to the effect described under Alternative 3A, but at a lesser magnitude because less landside work would be required, which would reduce the potential to interfere with drainage infrastructure. With implementation of Mitigation Measure FCGEOM-MM-2, this effect would be less than significant.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment

This effect would be the same as under Alternative 2A. Overall, direct effects related to arrest of bank erosion are considered to be less than significant because of the generally fixed nature of the river's planform. With implementation of Mitigation Measure FCGEOM-MM-1, indirect effects would be less than significant.

Effect FCGEOM-2: Increase in Levee Slope Stability

This effect would be the same as under Alternative 2A.

Effect FCGEOM-3: Decrease in Instream Woody Material Recruitment

This effect would be similar in type to the effect under Alternative 4A, but to a lesser extent because much of the existing vegetation and trees on the waterside slope and on the natural bank within 15 feet of the waterside toe would be protected. Overall, this effect would be significant. With implementation of Mitigation Measure FISH-MM-2: Compensate for Loss of Fish Habitat and Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat, this effect would be less than significant.

Effect FCGEOM-4: Changes in Local Hydraulics and Shear Stress

This effect would be the same as under Alternative 2A. With implementation of Mitigation Measure FCGEOM-MM-1, this effect would be less than significant.

Effect FCGEOM-5: Minimization of Stream Energy and Associated Floodplain Scour and/or Deposition

This effect would be similar in type as under Alternative 3A, but at a lesser magnitude because fewer setback levees would be constructed under Alternative 6A.

Effect FCGEOM-6: Substantially Alter the Existing Drainage Pattern of the Site or Area

This effect would be similar to the effect described in Alternative 3A, but at a lesser magnitude because less landside work would be required, reducing the potential to interfere with drainage infrastructure. With implementation of Mitigation Measure FCGEOM-MM-2, this effect would be less than significant.

Chapter 5
Water Quality and Groundwater Resources

Introduction and Summary

This chapter describes the environmental setting associated with water quality and groundwater resources, the determination of effects, the environmental effects on surface water and groundwater quality that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- Program area county general plans.
- American River Parkway Plan (Sacramento County 2008).
- Existing Sacramento River Bank Protection Project (SRBPP) documents:
  - Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites: Sacramento River Bank Protection Project (U.S. Army Corps of Engineers 2009).
  - Final Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009: Sacramento River Bank Protection Project, Sacramento River and Tributaries, California (U.S. Army Corps of Engineers 2008).
  - Environmental Assessment/Initial Study for Five Critical Erosion Sites, River Miles 26.9 Left, 34.5 Right, 72.2 Right, 99.3 Right, and 123.5 Left Sacramento River Bank Protection Project, Draft (U.S. Army Corps of Engineers 2006a).
  - Environmental Assessment for levee repair of 14 Winter 2006 critical sites, Sacramento River Bank Protection Project, Final Report (U.S. Army Corps of Engineers 2006b).

Table 5-1 summarizes the water quality effects resulting from the implementation of the proposed program.

Table 5-1. Summary of Water Quality Effects and Mitigation

Effect	Mitigation Measure	Implementation Period
WQ-1: Temporary Increase in Turbidity and Suspended Solids During Construction	WQ-MM-1: Monitor Turbidity during Construction	During construction
WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction	WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality	Prior to and during construction

Environmental Setting

This section discusses the existing conditions related to surface water quality and groundwater quality in the program area. The program area extends south-to-north along the Sacramento River from the town of Collinsville (just north of Antioch) at river mile (RM) 0, upstream to Chico at RM 194, and includes reaches of lower Elder and Deer creeks, Cache Creek, the lower reaches of the American River (RM 0–23), Feather River (RM 0–61), Yuba River (RM 0–11), Bear River (RM 0–17), as well as portions of Threemile, Steamboat, Sutter, Miner, Georgiana, and Cache sloughs (Figure 2-1).

The program area is located in the drainage basin of the Sacramento River system. The Sacramento River drainage area covers approximately 27,000 square miles, including the Feather River drainage basin, which totals approximately 5,500 square miles, and the American River drainage basin, which totals approximately 2,100 square miles (U.S. Army Corps of Engineers 2009).

The Feather River, the largest tributary to the lower Sacramento River, originates in the Sierra Nevada and Cascade Mountains. The combined flows of the Feather River and its tributaries (including Honcut Creek, and Yuba and Bear Rivers) enter the Sacramento River near Verona (approximately 5 miles northwest of the Sacramento International Airport). The three forks of the American River originate in the Sierra Nevada; the lower American River joins the Sacramento River in the city of Sacramento. Deer Creek, in Tehama County, is an eastside tributary to the Sacramento River and drains 134 square miles (Travers 1998). Elder Creek, the northernmost erosion site in the program area, joins the Sacramento River 12 miles south of the town of Red Bluff; the stream is normally dry from July to late fall (Sacramento River Watershed Program 2012). Cache Creek flows from Clear Lake across Yolo County into a settling basin in the Yolo Bypass west of the Sacramento River. The Yolo Bypass and Sutter Bypass are part of an engineered flood management system. The Yolo Bypass also receives water from the Sacramento River, the Knight's Landing Ridge Cut, Willow Slough, and Putah Creek; the Sacramento Bypass receives water from the Butte Creek drainage system and from the Sacramento River at flood stage via the Tisdale Weir (U.S. Army Corps of Engineers 2009). The Delta sloughs, Threemile, Steamboat, Sutter, Miner, Georgiana, and Cache, are located at the southernmost boundary of the program area in the Sacramento-San Joaquin Delta.

Existing Conditions

Surface Water Quality

Water management operations at Shasta Dam and other flow-regulating facilities substantially influence the flow regime of the Sacramento River. Water quality dynamics also have been influenced by the operation of these flow-regulating facilities. The Sacramento River and its tributaries are generally characterized as having good overall water quality, with relatively cool water temperatures, low biochemical oxygen demand, medium to high dissolved oxygen (DO), and low mineral and nutrient content. Snowmelt serves as the primary water source for the river system. Further downstream, as water flows through the Central Valley, the river receives various pollutants and constituents associated with human activities, and water quality typically decreases. Major sources of added constituents include eroded soils, agricultural return flows, urban runoff, and discharges from municipal wastewater treatment facilities.

Known contaminants in the Sacramento River include dioxin (from paper mills), mercury, organophosphate pesticides, and constituents in acid mine drainage, agricultural runoff, and municipal non-point source pollution (U.S. Geological Survey 2009a). Both total mercury and methyl-mercury have been detected at elevated levels in samples from the American, Feather, and Sacramento Rivers by the California State Toxic Substance Monitoring Program (U.S. Geological Survey 2009a).

Section 303(d) of the Clean Water Act (CWA))33 United States Code Section 1313(d)) requires states, territories, or authorized tribes to identify water bodies with impaired water quality (i.e., affected by the presence of pollutants or contaminants). These impaired water bodies are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDLs) for 303(d)-listed waters. A TMDL is the maximum quantity of a particular contaminant that a water body can receive and still meet water quality standards. Several reaches of the Sacramento River and its tributaries have been classified as impaired.

California's 2006 303(d) list indicates that the Sacramento River and its tributaries within the program area are impaired for mercury, diazinon and chlorpyrifos (organophosphate pesticides), pH, and Group A pesticides[1] (California State Water Resources Control Board 2006). The Delta waterways in the program area, including Threemile, Steamboat, Sutter, Miner, Georgiana, and Cache Sloughs, are impaired for diazinon, chlorpyrifos, DDT (dichlorodiphenyltrichloroethane), mercury, Group A pesticides, and PCBs (polychlorinated biphenyls) (California State Water Resources Control Board 2006). The following sections discuss specific contaminants of concern in relation to the implementation of the proposed program on the Sacramento River and relevant program area tributaries and water bodies.

Total Suspended Solids and Turbidity

Total suspended solids (TSS) are suspended or colloidal particles in water which do not settle out by gravity. In surface water, TSS is indicative of upstream scouring, bank erosion, and agricultural return flow transporting and depositing sediment. Suspended sediment is considered a pollutant by the Central Valley Regional Water Quality Control Board (Central Valley RWQCB) and can transport other contaminants (e.g., phosphorus) and hydrophobic contaminants (e.g., organochlorine pesticides). Typical TSS concentrations in the upper reaches of the Sacramento River range from 1 to 5 milligrams per liter during summer and fall months to 50–100 milligrams per liter during winter and spring months (U.S. Army Corps of Engineers 2006a). Seasonal and storm-event variability in TSS is due to increased overland flow and erosion with increased precipitation.

Mean monthly TSS for water samples taken from the Sacramento River at Colusa, Verona, and Freeport U.S. Geological Survey gages ranges from 19.4 milligrams per liter (October at Freeport) to 413.5 milligrams per liter (February at Colusa) (U.S. Army Corps of Engineers 2006a). With the exception of October, total suspended solids were greatest at Colusa than at Verona and Freeport (Table 5-2).

[1] Group A pesticides are aldrin, dieldrin, endrin, endosulfan, heptachloroepoxide, toxaphene, chlordane, lindane, and heptachlor.

Table 5-2. Monthly Average TSS for Sacramento River at Colusa, Verona, and Freeport

	Colusa (USGS gage 11389500)		Verona (USGS gage 11425500)		Freeport (USGS gage 11447650)	
Month	TSS (milligrams/liter)	Count	TSS (milligrams/liter)	Count	TSS (milligrams/liter)	Count
January	366	26	122	5	154	81
February	414	24	93	3	134	70
March	218	22	82	3	105	97
April	103	8	76	3	57	80
May	83	6	62	2	45	82
June	57	5	42	2	28	119
July	41	5	33	2	27	72
August	41	5	40	30	32	54
September	42	5	31	2	34	74
October	36	4	38	2	19	59
November	141	11	33	3	56	64
December	260	9	139	3	81	103

TSS = total suspended solids.
Count: Number of data points on which TSS statistic is based.
Source: U.S. Army Corps of Engineers (2006a)
Note: The range of years for which the TSS values were averaged was not provided in the referenced 2006 Corps document.

Turbidity is the reduction of water clarity due to the presence of suspended or colloidal particles and is commonly used as an indicator for the general condition of water clarity. Turbidity in surface water is comprised of naturally occurring and/or introduced organic matter and inorganic minerals, such as silt, clay, industrial waste, sewage, and algae. It is quantified according to the amount of light that is reflected by the suspended particles and is measured in nephelometric turbidity units (NTUs). Turbidity is closely related to TSS, but also includes plankton and other organisms (Murphy 2009).

The Central Valley RWQCB's Water Quality Control Plan (Basin Plan [California Regional Water Quality Control Board 2011]) states increases in turbidity attributable to controllable water quality factors shall not exceed the following limits.

- Where natural turbidity is less than 1 NTU, controllable factors shall not cause downstream turbidity to exceed 2 NTU.
- Where ambient turbidity is 1–5 NTUs, increases shall not exceed 1 NTU.
- Where natural turbidity is 5–50 NTUs, increases shall not exceed 20%.
- Where natural turbidity is 50–100 NTUs, increases shall not exceed 10 NTUs.
- Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10%.

The Basin Plan states that averaging periods can be applied as long as beneficial uses are fully protected. The turbidity objectives for the American River (Folsom Dam to Sacramento River) indicate that turbidity shall be less than or equal 10 NTUs, except during periods of storm runoff; should there be any conflict with the general turbidity objective, the more stringent limit applies (California Regional Water Quality Control Board 2011). For Delta waters, the general objectives for turbidity apply except during periods of storm runoff; during these periods, the turbidity of Delta waters shall not exceed 50 NTUs in the Central Delta and 150 NTUs in the surrounding Delta areas (California Regional Water Quality Control Board 2011). Specific construction projects that are part of the proposed program will need to comply with the above-stated thresholds for turbidity.

Monthly mean turbidity data for two locations along the Sacramento River (Verona and Hood) is presented in Table 5-3. This data provide a generalized determination of baseline turbidity along the Sacramento River. In many cases turbidity data is not available for other program area locations and was not included in this setting. Data for Verona are 15-minute data from February 2008 to August of 2009. Data for Hood are hourly data from March of 2007 to August of 2009. Turbidity at Verona tends to be higher than turbidity near Hood. This is likely due to the Feather River inflow just upstream of the gauge.

Table 5-3. Monthly Average Turbidity for Sacramento River at Verona and near Hood

	Sacramento River at Verona		Sacramento River at Hood	
	Mean	Count	Mean	Count
January	98	2,826	45	1,477
February	185	4,266	58	1,364
March	108	5,768	21	1,485
April	37	5,745	11	2,077
May	23	5,951	13	2,230
June	12	5,539	14	2,145
July	9	5,308	17	2,231
August	10	3,956	9	1,728
September	11	2,859	10	1,437
October	17	2,895	6	1,485
November	56	2,875	10	1,422
December	23	2,492	14	1,482

Note: “Count” values represent the total number of samples collected for each mean calculation.
Source: California Data Exchange Center, <http://cdec.water.ca.gov/>.

Dissolved Oxygen, Temperature, Electrical Conductivity, and pH

DO is a critical component for all forms of aquatic life. DO concentrations can be highly variable and are subject to large oscillations over short time periods. Factors that affect DO concentrations include: water volume and velocity; climate and season; type and number of aquatic organisms present; altitude; dissolved or suspended solids; nutrient concentrations; riparian vegetation; organic waste; and groundwater inflow. For example, in slow stagnant waters, much of the oxygen is confined to the top layer of water, and deeper water is often low in DO due to bacterial decomposition of organic matter. Additionally, high levels of nutrient loading can cause algal blooms. These blooms can cause large swings in DO levels as the algae populations fluctuate in size, producing oxygen while growing and consuming it while decaying. When DO concentrations fall below certain limits, the resulting low-DO zones can act as a barrier to fish migration and potentially adversely affect spawning success. In extreme cases, persistent low concentrations of DO can result in mortality of benthic organisms and other less-mobile aquatic species.

The Basin Plan objective for DO in the Sacramento River, from the I Street Bridge to the Delta, is 7 milligrams per liter. In general, for surface water bodies outside the legal Delta boundaries, DO concentrations must meet the following minimum levels: warm waters, 5 milligrams per liter; cold and spawning waters, 7 milligrams per liter (Central Valley Regional Water Quality Control Board 2011). More stringent Basin Plan DO objectives apply to the Sacramento River from Keswick Dam to Hamilton City (9 milligrams per liter from June 1 to August 31, or at or above 95% of saturation when DO is lower than 9 milligrams per liter due to natural conditions). The Sacramento River DO concentration near Freeport averages as high as 10.5 during the storm season and as low as 7.8 milligrams per liter during the dry season when flow is lower (Table 5-4). Discharges of fuel, oil, solvents and other petroleum-based products during construction activities could potentially affect DO concentrations in the immediate program vicinity by creating a film on the water's surface and limiting oxygen exchange.

Table 5-4. Monthly Average Physical Data for the Sacramento River at Freeport (2003 to 2009)

Month	Temperature (°F)	pH (Standard)	DO (milligrams /liter)	EC (µs/cm)
January	48.7	7.5	10.5	170
February	50.9	7.4	10.1	170
March	55.3	7.5	9.7	154
April	58.3	7.4	9.6	138
May	64.3	7.4	8.6	145
June	68.8	7.3	8.2	139
July	71.1	7.3	7.9	134
August	71.0	7.4	7.8	156
September	67.9	7.5	8.0	166
October	62.5	7.2	8.6	145
November	55.9	7.4	8.9	186
December	49.5	7.4	10.2	186

DO = dissolved oxygen.
EC = electrical conductivity.
Source: California Data Exchange Center data: <http://cdec.water.ca.gov/>.

Water temperature affects the concentration of dissolved oxygen and is an important water quality variable for aquatic life. The Basin Plan water temperature objective requires that the temperature not exceed 56°F in the Sacramento River from Keswick Dam to Hamilton City, and not exceed 68°F from Hamilton City to the I Street Bridge during periods when temperature increases would be detrimental to the fishery (California Regional Water Quality Control Board 2007). In addition, the Basin Plan water temperature objective also requires that the temperature not deviate more than 5° F from ambient river temperature. Annual water temperatures for the Sacramento River at Freeport range from approximately 49°F (January) to 71°F (August) (Table 5-4). While an unlikely scenario, excessive sedimentation resulting from the proposed program's construction activities could affect the temperature of the Sacramento River and other program area water bodies.

Electrical conductivity (EC) of water is directly related to the concentration of dissolved ionized solids in the water; the higher the EC of a particular sample of water, the higher the concentration of total dissolved solids (TDS). TDS and EC are general indicators of salinity and are regulated under the Basin Plan. Basin Plan objectives for EC on the Sacramento River are 340 microsiemens per centimeter (μS/cm). Annual EC values for the Sacramento River at Freeport range from 138 μS/cm (April) to 186 μS/cm (December) (Table 5-4).

Potential of hydrogen (pH) represents the effective concentration (activity) of hydrogen ions in water is reported on a scale from 0 (acidic) to 14 (alkaline), with pure water at 7 (neutral). The Basin Plan objective for pH is between 6.5 and 8.5, and discharges cannot result in changes of pH that exceed 0.5 above normal ambient pH with designated cold or warm beneficial uses. The pH of the Sacramento River is generally stable throughout the year (Table 5-4), and ranges from 7.2 to 7.5. Because no strong acids, bases, or concrete would be used during construction activities, significant effects on pH in the program area are not anticipated.

Groundwater Resources

The California Department of Water Resources (DWR) delineates groundwater basins throughout California under the state's Groundwater Bulletin 118 (California Department of Water Resources 2003). The program area is located in the Sacramento Valley Groundwater Basin, which is in the Sacramento River Hydrologic Region. The Sacramento Valley Groundwater Basin is subdivided into 18 subbasins: Red Bluff, Corning, Colusa, Bend, Antelope, Dye Creek, Los Molinos, Vina, West Butte, East Butte, North Yuba, South Yuba, Sutter, North American, South American, Solano, Yolo, and Capay Valley. In the Central Valley, of which the Sacramento Valley comprises approximately one-third and the San Joaquin Valley comprises approximately two-thirds, the surface-water delivery system redistributes a significant portion of the water from north to south (U.S. Geological Survey 2009b).

Due to the relative abundance of surface water in the Sacramento Valley, the Sacramento Valley and the Delta generally experience relatively minimal groundwater-storage depletion; groundwater accounts for less than 30% of the annual supply used for agricultural and urban purposes in this area (U.S. Geological Survey 2009b). In the Sacramento Valley, groundwater that is pumped can be replenished annually during the non-irrigation season by recharge from precipitation and streams; groundwater recharge in the Sacramento Valley primarily is from precipitation (U.S. Geological Survey 2009b).

Groundwater quality in the Sacramento River Hydrologic Region is considered excellent overall (California Department of Water Resources 2003). However, there are areas with local groundwater problems. For example, water quality impairments occur at the north end of the Sacramento Valley in the Redding subbasin and along the margins of the valley, as well as around the Sutter Buttes, where Cretaceous-age marine sedimentary rocks containing brackish to saline water are near the surface; water quality is degraded from the older underlying sediments mixing with the fresh water in the younger alluvial aquifer (California Department of Water Resources 2003). Wells constructed in these areas typically have high TDS.

In the western portion of the Sacramento River Hydrologic Region, the groundwater in the volcanic and geothermal areas is impaired by moderate levels of hydrogen sulfide (California Department of Water Resources 2003). Human-induced impairments of groundwater quality are generally associated with individual septic system development in shallow unconfined sections of aquifers, or in areas of fractured hard rock where soil depths are insufficient to effectively leach effluent before it reaches the local groundwater supply.

In general, calcium-magnesium bicarbonate and magnesium-calcium bicarbonate are the predominant groundwater types throughout the 18 subbasins in the Sacramento Valley Groundwater Basin (California Department of Water Resources 2003). Total dissolved solids concentrations vary somewhat between subbasins, and range from 24 to 1660 milligrams per liter; mean TDS concentrations throughout the 18 subbasins range from 207 to 574 milligrams per liter (California Department of Water Resources 2003).

Regulatory Setting

Appendix C, Regulatory Background, provides the federal, state and local laws, regulations, and policies that pertain to water quality and groundwater within the program area. The pertinent laws, regulations, and policies are listed below.

- Federal:
  - National Environmental Policy Act
  - Clean Water Act
- State:
  - California Environmental Quality Act
  - California Fish and Game Code
  - Porter-Cologne Water Quality Control Act
- Local:
  - American River Parkway Plan
  - Butte County General Plan
  - Colusa County General Plan
  - Glenn County General Plan
  - Placer County General Plan
  - Sacramento County General Plan
  - Solano County General Plan
  - Sutter County General Plan
  - Tehama County General Plan
  - Yolo County General Plan
  - Yuba County General Plan

Determination of Effects

Assessment Methods

Effects on water quality that could result from construction activities were qualitatively evaluated on the basis of construction designs and practices, construction materials, the location and duration of the activities, and the potential for water-quality or beneficial-use degradation of water bodies near the proposed program. Operational effects on surface water quality and groundwater quality were evaluated qualitatively on the basis of the proposed program's potential to significantly alter the surface runoff patterns, increase the quantity of runoff, or generate additional sources of pollution.

Significance Criteria

For the purposes of this analysis, an effect was considered to be significant and to require mitigation if it would result in one or more of the following, which are based on professional practice and Appendix G of the CEQA Guidelines (14 California Code of Regulations 15000 et seq.):

- Alteration in the quantity and quality of surface runoff;
- Degradation of water quality;
- Reduction in groundwater quality.

Change or alteration of downstream drainage patterns is addressed in Chapter 4, Flood Control and Geomorphology. For the purposes of this analysis, it was determined that implementation of any of the action alternatives would not result in any indirect effects to surface water hydrology, hydrogeology and groundwater quality and therefore indirect effects are not discussed further. This determination was made because the nature of the actions; while they may affect local hydraulics (as previously discussed in Chapter 4, Flood Control and Geomorphology), they will not alter the amount or timing of flows and therefore would not affect hydrology. Similarly, none of the actions incorporate features that will alter the permeability of soils at a scale that would affect hydrogeology. Finally, due to the localized nature of the actions and the relatively minor potential for direct effects to groundwater quality at a local scale (as discussed below), the potential for indirect effects to groundwater quality will not result from implementation of the proposed program.

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, regular O&M of the levee system would continue as presently executed by the local maintaining entities (subject to revision of the governing O&M manual), but the Corps would not implement bank protection along Sacramento River Flood Control Project levees. As a result, erosion would continue and the risk of levee failure and subsequent flooding would increase. If a levee breach were to occur, emergency construction and repair activities would be implemented without the use of Best Management Practices (BMPs) and could result in release of contaminants into the soil (groundwater) and adjacent surface water, as well as increased erosion, which could raise TSS and turbidity in adjacent water bodies. If floodwaters were conveyed beyond the levees throughout the program area, water quality could be significantly affected due to increases in total suspended solids and turbidity. Additionally, water quality effects due to levee failure in which flooding occurs in urban, suburban, and agricultural areas would likely be significant and could include bacterial and chemical (e.g., pesticides, petroleum products, heavy metals) contamination.

Alternative 2A—Low Maintenance

Effect WQ-1: Temporary Increase in Turbidity and Suspended Solids during Construction

Alternative 2A entails installing revetment along the levee slope and streambank; if the bank is revegetated, vegetation would be limited to non-woody vegetation, such as grass. The placement of revetment within the channel would temporarily generate increased turbidity in the immediate vicinity of the construction area. Additionally, placement of revetment in the water could result in a sediment plume, generated from the channel bottom and levee side, becoming suspended in the water and could generate turbidity levels above those identified as acceptable by the Basin Plan (California Regional Water Quality Control Board 2007). Waterside construction would include the potential for additional turbidity impacts from erosion due to wave action generated during boat and barge operations. Turbidity effects on water quality from landside construction (e.g., vehicle staging, placement of construction equipment) would be limited to stormwater runoff carrying loose soil from staging areas and construction vehicle access areas. To limit erosion potential, the following measures are the types of erosion control measures that would be considered for implementation under the Stormwater Pollution Prevention Plan (SWPPP), as required by the State Water Resources Control Board as part of the National Pollutant Discharge Elimination System (NPDES) permitting process (including any Waste Discharge Requirements (WDRs)) for any construction activities that disturb more than 1 acre. These measures would avoid or minimize increases in turbidity and suspended solids.

- **Timing of construction**. Conduct earthwork during low flow periods (July 1–November 30) for those sites within the program area that are outside of the Delta.
- **Staging of construction equipment and materials**. To the extent possible, stage construction equipment and materials on the landside of the subject levee reaches in areas that have already been disturbed.
- **Soil and vegetation disturbance**. Minimize ground and vegetation disturbance during project construction by establishing designated equipment staging areas, ingress and egress corridors, spoils disposal and soil stockpile areas, and equipment exclusion zones prior to the commencement of any grading operations. Do not remove soil below the mean summer water line in order to minimize the mobilization of contaminated sediments (e.g., mercury).
- **Grading spoils**. Stockpile soil and grading spoils on the landside of the subject levee reaches, and install sediment barriers (e.g., silt fences, fiber rolls, and straw bales) around the base of stockpiles to intercept runoff and sediment during storm events. If necessary, cover stockpiles with geotextile fabric to provide further protection against wind and water erosion.
- **Sediment barriers**. Install sediment barriers on graded or otherwise disturbed slopes as needed to prevent sediment from leaving the project site and entering nearby surface waters.
- **Site stabilization**. Install plant materials to stabilize cut and fill slopes and other disturbed areas once construction is complete. Plant materials may include an erosion control seed

mixture or shrub and tree container stock. Temporary structural BMPs, such as sediment barriers, erosion control blankets, mulch, and mulch tackifier, may be installed as needed to stabilize disturbed areas until vegetation becomes established.

In addition, implementation of Mitigation Measure WQ-MM-1 would ensure that effects would be less than significant.

Mitigation Measure WQ-MM-1: Monitor and Control Turbidity during Construction

The Corps or its contractor will conduct water quality tests specifically for increases in turbidity and sedimentation caused by construction activities. If increases in turbidity above the identified limits are found then additional site-specific turbidity control measures will be implemented that avoid the effect and return turbidity levels to less than the identified limits. The primary measure is to slow the rate of construction and placement of revetment. Depending on the site-specific conditions, using additional sediment barriers may also reduce turbidity.

- **Sampling location**. Water samples for determining background levels shall be collected in the Sacramento River or affected adjacent water body (depending on erosion site) within the general vicinity for each erosion construction site. Testing to establish background levels shall be performed at least once a day when construction activity is in progress. Water samples for determining down current conditions shall be collected in the Sacramento River (or affected adjacent water body) at a point 5 feet out from the shoreline and 300 feet down current of each erosion site. During periods when there are no in-water construction activities, random, weekly water monitoring will be performed. During periods of in-water construction, water monitoring will occur hourly.

- **Turbidity**. During working hours, the construction activity shall not cause the turbidity in the Sacramento River (or affected adjacent water body) down current from the construction sites to exceed the Basin Plan turbidity objectives. Specifically, where natural turbidity is between 0 and 5 NTUs, increases shall not exceed 1 NTU; where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20%; where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs; and where natural turbidity is greater than 100 NTUs, increases shall not exceed 10% (California Regional Water Quality Control Board 2007). In determining compliance with these limits, appropriate averaging periods may be applied provided that beneficial uses will be fully protected.

Effect WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction

Fuel, oils, grease, solvents and other petroleum-based products are commonly used in construction activities. Accidental releases of the products could degrade surface water and groundwater quality. As described in Appendix C, Regulatory Background, implementation of the proposed program would adhere to a SWPPP and Spill Prevention, Control, and Countermeasure Plan (SPCCP). The purpose of an SPCCP is to minimize the potential for and effects from spills of hazardous, toxic, or petroleum substances during construction and operation activities. An SPCCP would be completed before any construction activities begin, and implementation of the SPCCP would comply with the Porter-Cologne Water Quality Control Act of 1969 and the Clean Water Act. The SPCCP will describe spill sources and spill pathways in addition to the actions that would be taken in the event of a spill (e.g., an oil spill from engine refueling will be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containment facilities and practices such as double-walled tanks, containment berms and other secondary control measures, emergency shutoffs, drip pans, fueling procedures, and spill response kits. It will describe how and when employees are trained in proper handling and spill prevention and response procedures.

The Corps would review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. The Corps would notify its contractors immediately if there is a noncompliance issue and will require compliance.

The federal reportable spill quantity for petroleum products, as defined in 40 Code of Federal Regulations (CFR) Section 110.3[2], is any oil spill that:

- Violates applicable water quality standards.
- Causes a film or sheen on or discoloration of the water surface or adjoining shoreline.
- 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 would notify the Corps, and the Corps would take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. A written description of reportable releases must be submitted to the Central Valley RWQCB. 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 would be documented on a spill report form.

If a significant spill were to occur, even with implementation of the SPCCP, and it was determined that the surface water or groundwater quality have been significantly affected, Mitigation Measure WQ-MM-2 would minimize the significant effect to less than significant.

Mitigation Measure WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality

If an appreciable spill occurs and results determine that project activities have adversely affected surface or groundwater quality, a detailed analysis will be performed immediately by a registered environmental assessor or professional engineer to determine the extent of contamination. This analysis will conform to American Society for Testing and Materials standards, and will include recommendations for reducing or eliminating the source or mechanisms of contamination. Based on this analysis, the Corps and its contractors will select and implement measures to control the contamination, with a performance standard that surface water quality and groundwater quality must be returned to baseline conditions. Remedial measures that would be implemented when the spill has already come into contact with surface or groundwater may include, but are not limited to, the following:

[2] According to the Clean Water Act, Section 311, Section1321(b)(5), a spill must be reported if it is in violation of Section1321(b)(3), which prohibits spills of a quantity that "may be harmful" to the public health or welfare or the environment of the United States. 40 CFR Section 110.3 defines what a quantity that "may be harmful" to the public health or welfare or the environment of the United States is. Therefore, 40 CFR Section110.3 defines reportable spill quantity.

- Absorbent booms and pads can be used to contain the spread of the spill and soak up oil or other chemical that sorbs to solids as opposed to liquids.
- Mechanical skimmers, draglines, or dredges can be used to recover floating oil from the water surface where substantial oil has accumulated.
- If remaining oil/chemical cannot be removed, dispersants can be used to reduce impact to sensitive shoreline habitats and animals that use the water surface by chemically dispersing oil into the water column.
- According to the SPCCP, samples must be collected within the first two hours of discharge at all affected discharge locations, as well as an area unaffected by the release, when a spill occurs that exposes pollutants to runoff.
- For a significant or hazardous spill that cannot be controlled by personnel in the immediate vicinity, the local emergency agency should be contacted by dialing 911 and notifying the proper county officials.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect WQ-1: Temporary Increase in Turbidity and Suspended Solids during Construction

Construction-related effects associated with Alternative 3A would be comparable in type, but of a lower magnitude, to those described above for Alternative 2A. Because the majority of construction activities would take place some distance landward of the existing levee, there would be less potential for significant effects on water quality due to excessive turbidity or TSS. Incorporation of SWPPP measures, as described above for Alternative 2A, would limit erosion potential. Implementation of Mitigation Measure WQ-MM-1 would ensure that effects would be less than significant.

Effect WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction

Construction-related effects associated with Alternative 3A would be comparable in type, but of a lower magnitude, to those described above for Alternative 2A. Because a majority of construction activities would take place some distance landward of the existing levee, there would be less potential for significant effects on water quality due to the accidental release of hazardous materials. Mitigation Measure WQ-MM-2 would minimize the significant effect on water quality potentially resulting from the accidental release of hazardous materials to surface or groundwater. Consequently, construction-related effects on water quality would be less than significant.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect WQ-1: Temporary Increase in Turbidity and Suspended Solids during Construction

Effects associated with Alternative 4A would be comparable in type and magnitude to those described above for Alternative 2A. Placement of rock and soil during construction of the riparian and wetland benches, as well as placement of instream woody material (IWM), could potentially result in the generation of additional turbidity; this effect, however, would be temporary.

Additionally, the inclusion of setback and adjacent levees could potentially lessen the generation of turbidity, as described above for Alternative 3A.. Incorporation of SWPPP measures, as described above for Alternative 2A, would limit erosion potential. Implementation of Mitigation Measure WQ-MM-1 would ensure that effects would be less than significant.

Effect WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction

Effects associated with Alternative 4A would be comparable in type and magnitude to those described above for Alternative 2A. Mitigation Measure WQ-MM-2 would minimize the significant effect on water quality potentially resulting from the accidental release of hazardous materials to surface or groundwater. Consequently, construction-related effects on water quality would be less than significant.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect WQ-1: Temporary Increase in Turbidity and Suspended Solids during Construction

Effects associated with Alternative 5A would be comparable in type and magnitude to those described above for Alternative 2A. Placement of rock and soil during construction of the riparian and wetland benches, as well as placement of IWM, could potentially result in the generation of additional turbidity; this effect, however, would be temporary. Additionally, the inclusion of setback and adjacent levees could potentially lessen the generation of turbidity, as described above for Alternative 3A. Incorporation of SWPPP measures, as described above for Alternative 2A, would limit erosion potential. Implementation of Mitigation Measure WQ-MM-1 would ensure that effects would be less than significant.

Effect WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction

Effects associated with Alternative 5A would be comparable in type and magnitude to those described above for Alternative 2A. Mitigation Measure WQ-MM-2 would minimize the significant effect on water quality potentially resulting from the accidental release of hazardous materials to surface or groundwater. Consequently, construction-related effects on water quality would be less than significant.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect WQ-1: Temporary Increase in Turbidity and Suspended Solids during Construction

Effects associated with Alternative 6A would be comparable in type and magnitude to those described above for Alternative 2A. Placement of rock and soil during construction of the riparian and wetland benches, as well as placement of IWM, could potentially result in the generation of additional turbidity; this effect, however, would be temporary. Additionally, the inclusion of setback levees could potentially lessen the generation of turbidity, as described above for Alternative 3A. Incorporation of SWPPP measures, as described above for Alternative 2A, would limit erosion potential. Implementation of Mitigation Measure WQ-MM-1 would ensure that effects would be less than significant.

Effect WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction

Effects associated with Alternative 6A would be comparable in type and magnitude to those described above for Alternative 2A. Mitigation Measure WQ-MM-2 would minimize the significant effect on water quality potentially resulting from the accidental release of hazardous materials to surface or groundwater. Consequently, construction-related effects on water quality would be less than significant.

Chapter 6
Geology, Seismicity, Soils, and Mineral Resources

Introduction and Summary

This chapter describes the environmental setting associated with geology, seismicity, soils, and mineral resources, the determination of effects, the environmental effects on geology, seismicity, soils, and mineral resources that would result from implementation of the proposed action, and the mitigation measures that would reduce these effects.

Implications of programmatic alternatives for geology, seismicity, soils, and mineral resources conditions are also addressed within the context of the resources affected by the changes, most notably water quality and groundwater resources (Chapter 5); geomorphology and flood control (Chapter 4); vegetation and wetlands (Chapter 10); and fisheries and aquatics (Chapter 11).

The key sources of data and information used in the preparation of this chapter are listed below.

- Geologic map of the late Cenozoic deposits of the Sacramento Valley and northern Sierran foothills, California (Helley and Harwood 1985).
- Geomorphic Analysis and Bank Protection Alternatives Report for Sacramento River (RM 78-194) and Feather River (RM 0-28) (WET 1990).

Table 6-1 summarizes the geology, seismicity, soils, and mineral resources effects resulting from the implementation of the proposed program.

Table 6-1. Summary of Geology, Seismicity, Soils, and Mineral Resources Effects

Effect	Mitigation	Implementation Period
GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture	Not applicable	
GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking	Not applicable	
GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance	Not applicable	
GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation	Not applicable	

Environmental Setting

Program Area Description

As described in Chapter 2, Project Description, the program area encompasses more than 1,000 miles of levees and weirs. This area extends south-to-north along the Sacramento River, from the town of Collinsville (River Mile [RM] 0) upstream to Chico at RM 194. The program area also encompasses Cache Creek, the lower reaches of Elder and Deer creeks, the lower reaches of the American River (RM 0–23), Feather River (RM 0–61), Yuba River (RM 0–11), and Bear River (RM 0–17), portions of Threemile, Steamboat, Sutter, Miner, Georgiana, and Cache sloughs, as well as a number of flood bypasses and distributaries.

Geologic Conditions

Regional Physiographic Setting and Topography of the Program Area

The program area is located in the central and northern portions of the Sacramento Valley within California's Great Valley geomorphic province (California Geological Survey 2002). The Great Valley of California, also called the Central Valley of California, is a nearly flat alluvial plain extending from the Tehachapi Mountains in the south to the Klamath Mountains in the north and from the Sierra Nevada on the east to the Coast Ranges on the west. The valley is about 450 miles long and has an average width of about 50 miles. Elevations of the alluvial plain are generally just a few hundred feet above mean sea level (MSL), with extremes ranging from a few feet below MSL to about 1,000 feet above MSL (Hackel 1966).

The Sacramento Valley contains thousands of feet of accumulated fluvial, overbank, and fan deposits resulting from erosion of these surrounding ranges. The sediments vary from a thin veneer at the edges of the valley to 50,000 feet in the west-central portion and are estimated to be about 8,000 feet thick in the program area (Northwest Hydraulic Consultants 2007).

The Sacramento River is the main drainage of the region, flowing generally south from the Klamath Mountains to its discharge point into the Suisun Bay in the San Francisco Bay area. Many of the water courses in the program area have been confined by human-made levees since the turn of the last century. In the program area, these levees generally were constructed on Holocene age (less than 11,000 years old) alluvial and fluvial deposits deposited by the current and historical Sacramento River and its tributaries (Kleinfelder 2007).

The topography in the program area is mainly flat, with minimal rolling terrain towards the northern portion of the program area.

Regional Structural Geology

Geologically, the Great Valley geomorphic province is a large elongate northwest-trending asymmetric structural trough that, as described above, has been filled with a tremendously thick sequence of sediments ranging in age from Jurassic to Recent. This asymmetric geosyncline has a long stable eastern shelf supported by the subsurface continuation of the granitic Sierran slope and a short western flank expressed by the upturned edges of the basin sediments (Hackel 1966).

The structural patterns of the late Cenozoic era (65 million years before present) deformation in the Sacramento Valley differ significantly from that in the Coast Ranges to the west and that in the northern Basin and Range geomorphic province to the east (WET 1990). Deformation in the Sacramento Valley has occurred in a regional stress field with a maximum horizontal component of compressive stress that is oriented approximately east to west (Jordan and Minster 1988 as cited in WET 1990; Zoback et al. 1987 as cited in WET 1990).

In the past 5.2 million years (approximately the Pliocene, Pleistocene, and Holocene epochs), the compressive deformation has progressed northward so that resultant geologic structures in the northern part of the Sacramento Valley near Red Bluff are a million years younger than those near Sutter Buttes. Further south, near Sacramento, the observed deformation is older than 3.4 million years. Consequently, the effects of active tectonics on alluvial rivers in the program area should decrease southward. Harwood and Helley (1987 as cited in WET 1990) have divided the Sacramento Valley into what they refer to as “structural domains” (Figure 3.2 in WET 1990). In the program area, these domains include the Battle Creek, Corning, Chico, Sutter Buttes, and Sacramento domains.

The Battle Creek domain, at the northern end of the Sacramento Valley, contains late Cenozoic structures generated less than 0.5 million years ago. The Corning domain contains late Cenozoic structures generated between 0.5 and 1.0 million years ago. These structures range in orientation from northwest to north. Northwest-trending structures include the Willows fault (Figure 3.3 of WET 1990) and a fault along the flank of the South Corning dome. Structures that trend northward include the Corning fault, the Corning domes, and Los Molinos and Glenn Synclines. All of these structures deform the Red Bluff Formation, which is between 0.45 and 1.09 million years old (WET 1990). The Chico domain contains late Cenozoic structures generated between 1.0 and 2.6 million years ago.

Due to the unique style of tectonism, the Sutter Buttes are considered a single structural domain by Harwood and Helley (1987 as cited in WET 1990). The Sutter Buttes consist of a volcanic intrusion and associated faults and folds. The volcanics have been dated at 1.4 to 2.4 million years old. The intrusion extends beneath the buried Colusa dome – localization of the intrusion has been suggested to be due to offset on the Willows fault (Harwood and Helley 1987 as cited in WET 1990).

The Sacramento domain includes the possible southwest extension of the Willows fault beneath the Feather River near Nicolaus. None of the structures of the Sacramento domain have been shown to offset rocks younger than 3.4 million years old. Other structures in the Sacramento domain besides the Willows fault include the Stockton fault, the Midland fault, and the Thornton anticline (WET 1990).

Regional Surface Geology

The program area has been mapped by a number of geologists at a regional scale (Helley and Harwood 1985; Jennings 1977; Jennings and Strand 1960; Saucedo and Wagner 1992; Wagner and Bortugno 1982; Wagner et al. 1987). Jennings (1977), Jennings and Strand (1960), Saucedo and Wagner (1992), and Wagner et al. (1987) are compilation maps that reflect mapping by previous authors and accordingly portray geologic interpretations similar to Helley and Harwood (1985). Helley and Harwood’s (1985) mapping focused on Quaternary geologic units based on geomorphic surfaces and was performed at a scale of 1:62,500, making this mapping the most relevant information for engineering properties of near-surface deposits in the program area.

Helley and Harwood's (1985) mapping shows the Sacramento River in the program area crossing a number of Quaternary-age geologic units.

The riverine soils of the program area are discussed in Chapter 4, Flood Control and Geomorphology.

Seismic Hazards

Seismic hazards refer to earthquake fault ground rupture and ground shaking (primary hazards), as well as liquefaction and earthquake-induced slope failure (secondary hazards). Localized ground shaking and liquefaction are the most substantial seismic hazards in the program area.

Surface Fault Rupture and Faulting

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act[1] (Alquist-Priolo Act) is to regulate development near active faults to mitigate the hazard of surface rupture. Faults in an Alquist-Priolo Earthquake Fault Zone are typically active faults. As defined under the Alquist-Priolo Act, an active fault is one that has had surface displacement within Holocene time (about the last 11,000 years). An early Quaternary fault is one that has had surface displacement during Quaternary time (the last 1.6 million years). A pre-Quaternary fault is one that has had surface displacement before the Quaternary period.

There is no evidence of recent (i.e., Holocene) faulting within the program area and no faults are mapped to cut valley alluvium at or near the program area (Hart and Bryant 1997; International Conference of Building Officials 1997; Jennings 1994; U.S. Geological Survey 2009). Furthermore, review of aerial photographs does not indicate the presence of lineations or other features that would suggest the presence of recent faulting on or trending towards the program area.

However, the program area is subject to seismic hazards because of its proximity to active faults, fault systems, and fault complexes. Some of the officially recognized (e.g., by the State of California or Uniform Building Code [UBC]) active faults are located within a 20-mile radius of the program area. The closest active faults to the program area are the Dunnigan Hills Fault about 19 miles to the west, and the Cleveland Hill Fault (western splay of the Foothills Fault System) as close as 2.5 miles east of the program area (Hart and Bryant 1997; International Conference of Building Officials 1997; Jennings 1994; U.S. Geological Survey 2009). All of these faults are in Alquist-Priolo Earthquake Fault Zones (Hart and Bryant 1997).

The closest fault to the program area is the Willows Fault Zone, located less than 2 miles from the southern end of the program area. This fault zone is mapped as a pre-Quaternary fault zone; however, according to Kleinfelder (2008), it is defined as potentially capable of generating infrequent and moderate magnitude earthquakes along its northern extent north of the Sutter Buttes and is mapped on the basis of offset, deep (i.e., 1,500 feet) bedrock strata and associated groundwater elevation anomalies in that region.

---

[1] The Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Section 2621 et seq.) is a state law originally enacted in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. It is intended to prevent the construction of buildings used for human occupancy on the surface trace of active faults. Local agencies must regulate most development in fault zones established by the State Geologist known as Alquist-Priolo Earthquake Fault Zones. The proposed program's improvements would not entail the construction of buildings for human occupancy. Therefore, this law is not applicable to the proposed program.

Ground-Shaking Hazard

The program area is located in UBC Seismic Hazard Zone 3. The UBC recognizes no active seismic sources in the immediate vicinity of the program area (International Conference of Building Officials 1997).

The measurement of the energy released at the point of origin, or epicenter, of an earthquake is referred to as the magnitude, which is generally expressed in the Richter Magnitude Scale or as moment magnitude. The scale used in the Richter Magnitude Scale is logarithmic so that each successively higher Richter magnitude reflects an increase in the energy of an earthquake of about 31.5 times. Moment magnitude is the estimation of an earthquake magnitude by using seismic moment, which is a measure of an earthquake size utilizing rock rigidity, amount of slip, and area of rupture.

The greater the energy released from the fault rupture, the higher the magnitude of the earthquake. Earthquake energy is most intense at the fault epicenter; the farther an area from an earthquake epicenter, the less likely that ground shaking will occur there. Geologic and soil units comprising unconsolidated, clay-free sands and silts can reach unstable conditions during ground shaking, which can result in extensive damage to structures built on them (see Liquefaction Hazard section below).

Ground shaking is described by two methods: ground acceleration as a fraction of the acceleration of gravity (g) or the Modified Mercalli scale, which is a more descriptive method involving 12 levels of intensity denoted by Roman numerals. Modified Mercalli intensities range from I (shaking that is not felt) to XII (total damage).

The intensity of ground shaking that would occur within the program area as a result of a nearby earthquake is partly related to the size of the earthquake, its distance from the program area, and the response of the geologic materials within the program area. As a rule, the earthquake magnitude and the closer the fault rupture to the site, the greater the intensity of ground shaking. When various earthquake scenarios are considered, ground-shaking intensities will reflect both the effects of strong ground accelerations and the consequences of ground failure.

Liquefaction Hazard

Liquefaction is a phenomenon in which the strength and stiffness of unconsolidated sediments are reduced by earthquake shaking or other rapid loading. Poorly consolidated, water-saturated fine sands and silts having low plasticity and located within 50 feet of the ground surface are typically considered to be the most susceptible to liquefaction. Soils and sediments that are not water-saturated and that consist of coarser or finer materials are generally less susceptible to liquefaction (California Division of Mines and Geology 1997).

Geologic mapping by Helley and Harwood (1985) shows significant portions of the program area to be underlain by basin and Holocene age alluvial deposits. These units generally consist of unconsolidated gravel, sand, silt, and clay. Depending on groundwater levels and the intensity of a seismic event, these units have the potential to liquefy during a seismic event.

For example, in Butte County, areas paralleling the Sacramento River that contain clean sand layers with low relative densities are estimated to have generally high liquefaction potential. Granular layers underlying most of the remaining Sacramento Valley area of Butte County have higher relative densities and thus have moderate liquefaction potential. Clean layers of granular materials older than Holocene are of higher relative densities and are thus of low liquefaction potential. Figure 16-4 of the Butte County General Plan Technical Update, Background Report shows that the Sacramento River generally traverses areas of moderate liquefaction potential (Butte County 2005).

In Yuba and Sutter counties, areas with a high liquefaction potential are similar to those areas described for Butte County (Sutter County 2008; Yuba County 2008). In other words, areas paralleling the Sacramento, Feather, and Bear Rivers which contain clean sand layers with low relative densities coinciding with a relatively high water table are estimated to have generally high liquefaction potential. Granular layers underlying certain areas in the Sacramento Valley have higher relative densities and thus have moderate liquefaction potential.

Other Ground Failure Types Associated with Liquefaction

Two potential ground failure types associated with liquefaction in the program area are lateral spreading and differential settlement (Association of Bay Area Governments 2001). Lateral spreading involves a layer of ground at the surface being carried on an underlying layer of liquefied material over a gently sloping surface toward a river channel or other open face. Lateral spreading is expected to locally be a concern within the program area.

Another common hazard in the region is differential settlement (also called ground settlement and, in extreme cases, ground collapse) as soil compacts and consolidates after the ground shaking ceases. Differential settlement occurs when the layers that liquefy are not of uniform thickness, a common problem when the liquefaction occurs in artificial fills. Settlement can range from 1% to 5%, depending on the cohesiveness of the sediments (Tokimatsu and Seed 1984). Within the program area, differential settlement is also expected to be a concern locally.

Landslide Hazards

Aerial photographs were analyzed for the presence of landslides along and adjacent to waterways in the program area. No landslides were observed along the waterways in the program area. No geomorphic features indicative of landsliding were observed (e.g., scarps, hummocky topography).

Volcanic Hazards

The only county in the program area subject to volcanic hazards is the northern portion in Butte County. Some of the most striking topographic features of Butte County, including Table Mountain north of Oroville, are volcanic in origin. The lava flows which now cap Table Mountain and most of the other volcanic features in the county are, however, tens of millions of years old. The geologic activity producing this volcanism has long since ceased and thus there are virtually no volcanic hazards in most of Butte County. However, northern Butte County is an exception to this generalization because Lassen Peak, an active volcano, is only about 25 miles north of the Butte County line.

Lassen Peak is the southernmost volcano in the Cascade Range and last erupted in the period between 1914 and 1921; this period of volcanic activity included steam and ash eruptions as well as a small lava flow. Like the other volcanoes in the Cascades, Mount Lassen is considered dormant, which means that it is not currently erupting but is expected to erupt again in the future. Lassen Peak has erupted at least seven times within the past 1,200 years.

There are four main hazards that may accompany volcanic eruptions: 1) ash and cinder falls, 2) explosive blasts, 3) lava flows, and 4) mud flows. Despite the general severity of volcanic hazards, potential volcanic hazards for Butte County are limited to the northernmost portions of the county. Even here, the hazards are relatively modest because of the distance between Butte County and Lassen Peak. In historic times, there are no records of significant ash falls, explosive effects, lava flows or mud flows reaching Butte County. Furthermore, impending volcanic eruptions generally give numerous advance warning signs and thus it is usually possible to evacuate residents in areas subject to volcanic hazards (Butte County 2005).

Regulatory Setting

Appendix C, Regulatory Background, describes the state regulations, laws, and policies that pertain to geology, seismicity, soils, and mineral resources within the program area. Pertinent laws, regulations, and policies are listed below.

- Federal:
    - National Environmental Policy Act
- State:
    - California Environmental Quality Act
    - California Seismic Hazards Mapping Act
    - California Surface Mining and Reclamation Act
- Local:
    - County grading and erosion control ordinances
    - County general plans

Determination of Effects

This section lists the thresholds for significance under CEQA. In this joint federal and state EIS/EIR, reference to “significant impacts” is made to fulfill the requirement under CEQA, pursuant to standards of California law, and requirements of NEPA (40 Code of Federal Regulations Section 1502.16).

Assessment Methods

Evaluation of the geology, seismicity, soils, and mineral resources effects in this section is based on the information provided by technical maps, reports, and other documents that describe the geologic, seismic, soil, and mineral resource conditions of the program area. This information was then compared to the type of proposed improvements to determine whether effects would occur.

Significance Criteria

Criteria for determining the significance of effects related to geology, soils, and mineral resources were developed based on the environmental checklist form in Appendix G of the State CEQA

Guidelines (14 California Code of Regulations 15000 et seq.). An effect related to geology, soils, seismicity, and mineral resources was considered significant if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
    - rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the state geologist for the area or based on other substantial evidence of a known fault (refer to Division of Mines and Geology Special Publication 42);
    - strong seismic ground shaking;
    - seismic-related ground failure, including liquefaction; or
    - landslides;
- Result in substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project and potentially result in an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the UBC (1994), creating substantial risks to life or property;
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems in areas where sewers are not available for the disposal of wastewater;
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state; or
- Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

Effects and Mitigation Measures

See Chapter 4, Flood Control and Geomorphology, for additional effects that are closely related to geology and soils.

Additionally, landslides are not a concern in relation to the proposed program because the program area is relatively flat. The proposed improvements would not involve the construction of any structures intended for human occupancy or the construction or modification of any structure in an area subject to seismic ground shaking or seismic-related ground failure. Therefore, the proposed program of improvements would not expose people to potential substantial adverse effects, including the risk of loss, injury, or death, involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure, or landslides.

All bank protection/levee construction or modification conducted as part of the proposed program of improvements would be designed based on the results of detailed geotechnical engineering studies and would be required to comply with standard engineering practices for levee design. The CVFPB standards are the primary state standards applicable to SRBPP levee improvements; these are stated in Title 23, Division 1, Article 8, Sections 111–137 of the California Code of Regulations. As explained in Chapter 4, Flood Control and Geomorphology, the CVFPB standards direct that levee design and construction be in accordance with the Corps' Engineering Design and Construction of Levees, the primary federal standard applicable to levee improvements, and other applicable Corps standards. Because the design and construction of flood control improvements and maintenance of the facilities must comply with the regulatory standards of these agencies, it is assumed that the design and construction of all modifications to the flood control system under the proposed program would meet or exceed applicable design standards for static and dynamic stability, expansive soils, secondary effects related to ground shaking, and seepage.

Because the individual flood control projects would not involve the use of wastewater disposal systems of any kind, there would be no impact related to the ability of project site soils to support the use of septic systems. Therefore, these issues are not addressed further in this EIS/EIR. No indirect effects related to geology, soils, seismicity, and mineral resources have been identified in this analysis. The effects described below are all direct in nature.

Alternative 1—No Action

Under Alternative 1, no construction-related effects involving direct ground-disturbing activities or changes to flood control facilities that could result in changes in geology, seismicity, soils, or mineral resources would occur. Therefore, there would be no effects on these resources attributable to implementation of Alternative 1.

Furthermore, the beneficial effects attributable to proposed program implementation, such as improved bank stability and decrease of bank retreat, would not be realized under the Alternative 1 condition. Without proposed program improvements, the streambanks in the program area would remain susceptible to bank failure, increasing the risk of levee failure and subsequent flooding in the surrounding areas. A catastrophic levee failure would result in flooding and inundation that could result in severe damage to local soils, result in the formation of scour holes, and produce eroded and unstable landforms. However, given the uncertainty of the occurrence or magnitude of such an event in the immediate future and the next 50 years, the effects cannot be quantified based on available information.

Compliance with future vegetation management policy enforcement on the program area streambanks would not have any noteworthy program area-wide effects on geology, seismicity, soils, or mineral resources. However, local increases in velocity as a result of a decrease in bank roughness associated with vegetation removal may occur. These local increases in velocity would have the potential to exert greater forces on the streambanks in the downstream direction, locally promoting streambank instability and possibly introducing excess sediment into the system.

Alternative 2A—Low Maintenance

Effect GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture

There are no active faults or Alquist-Priolo Earthquake Fault Zones located in or immediately adjacent to the program area. Furthermore, the proposed program would not increase the present risk of fault rupture in the program area. Therefore, there would be no effect.

Effect GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking

Although the risk of strong ground shaking in the program area is relatively low for California, a large earthquake on a nearby fault could cause ground shaking in the program area that could result in levee deformation, liquefaction, or secondary ground failure, such as lateral spreading or differential settlement, which could result in structural loss, injury, and death.

Implementation of Alternative 2A would not substantially alter the overall composition of the levees or foundation soils. The risk associated with levee deformation would occur only when river levels were high and the potential for levee failure from ground shaking would depend on the degree of the levee saturation during an earthquake. High water levels and a high level of saturation would likely occur only during a major flood event. The probability that a large regional earthquake would occur during a major flood event is relatively low, but such coincidence is not impossible. Regardless, the purpose of the proposed program is to strengthen the levee against the threat of erosion. As a result, the overall strength of the levee would be increased to some extent rather than decreased. As a result, this effect is considered less than significant. No mitigation is required.

Effect GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance

The earthwork that would be required during construction of the various program improvements could result in substantial ground and vegetation disturbance. These disturbances would increase the hazard of erosion and could temporarily increase erosion, runoff, and sedimentation rates above existing levels. Because most of the earthwork would be conducted on and immediately adjacent to the program area streambanks, accelerated erosion, runoff, and sedimentation resulting from construction-related ground and vegetation disturbance would not result in the loss of appreciable quantities of topsoil resources. In addition, most ground-disturbing activities would occur during the dry season, further reducing the potential for construction-related erosion.

Site-specific measures to control erosion would be included in the SWPPP, as described in Chapter 5, Water Quality and Groundwater Resources, under Effect WQ-1. The SWPPP is a requirement of the National Pollutant Discharge Elimination System General Construction Permit.

Furthermore, compliance with the various county grading ordinances would minimize any negative effects associated with erosion, runoff, and sedimentation.

Finally, consistent with Mitigation Measures WQ-MM-1 and WQ-MM-2 (see Chapter 5, Water Quality and Groundwater Resources) the program proponent or its contractor would monitor turbidity in the program area waterways to determine whether turbidity is being affected by construction and ensure that construction does not affect turbidity levels or acceptable sedimentation loads. These actions would reduce erosion, runoff, and sediment-related effects to a level that is less than significant.

Effect GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation

Construction of Alternative 2A would require large amounts of important mineral resources, such as quarry stone and soil. The program area is located in the Central Valley region, where, although there are numerous permitted mineral resource supplies, they do not exceed the projected need over the next 50 years (Clinkenbeard 2012). However, there are substantial amounts of permitted aggregate resources available to supply the project needs. For example, permitted resources are 392 million tons in the Yuba City-Marysville region, 128 million tons in the Sacramento-Fairfield region (which includes Yolo County), and 42 million tons in Sacramento County (Clinkenbeard 2012). The amount of quarry stone and soil needed for the proposed program is, therefore, not expected to substantially affect the availability of these resources. Additionally, the proposed program would be implemented only along leveed river banks—areas in which mineral resource recovery is already prohibited because such activities would undermine the structural integrity of the SRFCP—which are not considered existing mineral resource recovery sites. This effect would be less than significant. No mitigation is required.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture

Effects associated with Alternative 3A would be similar to those described under Alternative 2A.

Effect GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking

Effects associated with Alternative 3A would be similar to those described under Alternative 2A.

Effect GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance

Effects associated with Alternative 3A would be similar to those described under Alternative 2A. However, a setback levee would require more substantial soil disturbance. Nonetheless, the water quality environmental commitment and mitigation measures (described in Chapter 5, Water Quality and Groundwater Resources) would apply and the effect would remain less than significant.

Effect GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation

Effects associated with Alternative 3A would be similar to those described under Alternative 2A.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture

Effects associated with Alternative 4A would be similar to those described under Alternative 2A.

Effect GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking

Effects associated with Alternative 4A would be similar to those described under Alternative 2A.

Effect GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance

Effects associated with Alternative 4A would be similar to those described under Alternative 3A.

Effect GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation

Effects associated with Alternative 4A would be similar to those described under Alternative 2A.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture

Effects associated with Alternative 5A would be similar to those described under Alternative 2A.

Effect GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking

Effects associated with Alternative 5A would be similar to those described under Alternative 2A.

Effect GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance

Effects associated with Alternative 5A would be similar to those described under Alternative 3A.

Effect GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation

Effects associated with Alternative 5A would be similar to those described under Alternative 2A.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture

Effects associated with Alternative 6A would be similar to those described under Alternative 2A.

Effect GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking

Effects associated with Alternative 6A would be similar to those described under Alternative 2A.

Effect GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance

Effects associated with Alternative 6A would be similar to those described under Alternative 3A.

Effect GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation

Effects associated with Alternative 6A would be similar to those described under Alternative 2A.

Chapter 7
Transportation and Navigation

Introduction and Summary

This chapter describes the environmental setting associated with transportation and navigation, the determination of effects, the environmental effects on transportation systems that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- Butte County General Plan, 2010.
- Colusa County General Plan, 2011.
- Glenn County General Plan, 1993.
- Placer County General Plan, 1994.
- Sacramento County General Plan, 2011.
- Solano County General Plan, 2008.
- Sutter County General Plan Policy Document, 2011.
- Tehama County General Plan, 2009.
- Yolo County General Plan, 2009.
- Yuba County General Plan, 2011.

Table 7-1 summarizes the transportation, circulation and navigation effects resulting from the implementation of the program alternatives.

Table 7-1. Summary of Transportation, Circulation and Navigation Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
TN-1: Temporary Increase in Traffic Volumes from Construction-Generated Traffic and Potential Degradation of level-of-service (LOS) for Roadways in the Vicinity of the Program	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Before and during construction
TN-2: Potential Increase in Safety Hazards Attributable to Construction-Generated Traffic	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Before and during construction
TN-3: Increase Emergency Response Times	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Before and during construction

Effect	Mitigation Measures	Implementation Period
TN-4: Potential Inadequate Parking Supply to Meet Parking Demand for Construction Equipment and Construction Workers	None required	N/A
TN-5: Potential Conflict with Alternative Transportation Modes because of Temporary Road Closures	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Before and during construction
TN-6: Temporary Changes to Navigation	None required	N/A
TN-7: Potential Rerouting of Roads	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Before and during construction

Environmental Setting

Existing Conditions

The highways and roads that would be used to transport materials, equipment, and personnel to the erosion sites receive widely varying levels of traffic. Existing traffic volumes not only vary widely among the road systems in the four regions, but they also vary in accordance with time of day and season of the year. Some areas receive little traffic because they are located on levee roads behind locked gates where public travel is restricted. Other areas are located along highways that receive substantial use. Some levees are located closer to urban areas and would require haul routes that include busy local roads. Other levees are located in sparsely populated agricultural areas, and haul routes would use roads with lower existing traffic levels. Roadway capacities also vary widely, as they are decided by factors such as alignment, shoulder width, passing sight distance, and the percentage of trucks, agricultural equipment, and other large vehicles that uses the roadway system.

Region 1a

Levees in Region 1a are located in parts of Yolo, Sacramento, and Solano Counties. Roads adjacent to the levees in this region are generally two-lane county roads, two-lane highways, or access roads, as the levees are primarily located in parts of the above counties that do not yet have urban development. The only city in Region 1a that is adjacent to a levee is the City of West Sacramento; however, only South River Road provides access to the levees in this area. Highways adjacent to levees in Region 1a, or that may be used as haul routes, include State Route (SR)12, SR 160, and SR 113, which are all two-lane highways. Interstate 5 (I-5) intersects two sections of the levees near the city of Woodland, and I-80 intersects sections located from west of the City of Davis to the northern side of the City of West Sacramento. I-5 is a four-lane highway in the areas where it intersects levees. I-80 has six lanes where it intersects the levees east of Davis, and eight lanes where it intersects the levees located west of Davis. Both I-5 and I-80 would be used as part of haul routes for the proposed program, because they are key components of the region’s transportation system. While it is not currently known where specific project sites will be located, local roads that could provide hauling access to large sections of SRBPP levees in Region 1a include SR 84 (Jefferson Boulevard) and 1980 Stat Boundary Road.

Navigation in Region 1a is primarily recreational, with areas in the southern part of the region accessible to commercial ships using the Sacramento River Deep Water Ship Channel to access the Port of West Sacramento, which is the farthest north commercial ships can reach within the region. Parts of the waterways in the region are also accessed by construction barges. Under Section 10 of the Rivers and Harbors Act, the Deep Water Ship Channel is considered a navigable water, as are portions of the Sacramento River that lie within the region.

Region 1b

Levees in Region 1b are located in parts of Sutter, Yolo, and Sacramento Counties. Roads adjacent to the levees in the program area are generally two-lane county roads, two-lane highways, or access roads; however, some city streets are adjacent to the levees as well, as the cities of Sacramento and West Sacramento are within the region. Highways adjacent to the levees in Region 1b, or that may be used as haul routes, include SR 160, SR 275, SR 99, and SR 70. SR 160 ranges from a two- to six-lane highway in areas near program reaches. SR 275 is a four-lane highway that runs from Highway 50 (US-50) to downtown Sacramento, and crosses the Sacramento River. SR 99 ranges from ten lanes where it is merged with I-5, to four lanes where it crosses SRBPP levees in the northern part of the region. SR 70 is a two-lane highway that runs parallel to the northernmost part of Region 1b levees. I-5 and 80, as well as US-50, cross levee sections in the region. I-5 ranges from ten lanes to four lanes in areas that are adjacent to, or perpendicular to, SRBPP levees. I-80 is a six-lane highway where it crosses the Sacramento River. US-50 is an eight-lane highway where it crosses the Sacramento River levees. I-5, I-80, and US-50 would be used as part of haul routes for the proposed program, because they are key components of the region's transportation system. While it is not currently known where specific project sites will be located, local roads that could provide hauling access to large sections of SRBPP levees in Region 1b include Garden Highway, South River Road, Old River Road, and Pacific Avenue.

Navigation in Region 1b is primarily recreational, with most areas accessible by construction barges. The Sacramento River is considered a navigable water from its mouth through the extent of the program area. The American River is considered a navigable water from its confluence with the Sacramento River up to Bradshaw Avenue, which is near the eastern end of the SRBPP levees that lie along the American River. However, barge access along the American River is typically very limited due to shallow depths.

The Sacramento International Airport is located near the northern part of Region 1b in Sacramento County, approximately 0.5 mile east of the Sacramento River. The Sacramento International Airport is the primary source of air travel in the Sacramento region.

Region 2

Levees in Region 2 are located in parts of Sutter, Colusa, Yuba, Glenn, and Butte Counties. Roads adjacent to the levees in the program area are generally two-lane county roads, two-lane highways, or access roads; however, some city streets are also adjacent to the levees. Highways adjacent to the levees in Region 2, or that may be used as haul routes, include SR 70, SR 65, SR 20, SR 99, SR 113, and SR 45. SR 70, SR 65, SR 113, and SR 45 are two-lane highways in areas where they run adjacent to or cross SRBPP levees. SR 20 ranges from a two-lane to a four-lane highway in the program area.

SR 99 ranges from a two-lane to a four-lane highway in the program area, and would also be used as a haul route for construction equipment and materials. I-5 is not located adjacent to SRBPP levees in Region 2 but could be used as a haul route. While it is not currently known where specific project sites will be located, local roads that could provide hauling access to large sections of SRBPP levees in Region 2 include Garden Highway, Jackson Road, Live Oak Boulevard, Lower Honcut Road, Colusa County Highway, Traynham Road, Cranmore Road, Wilson Bend Road, South Meridian Road, and Butte Slough Road.

Navigation in Region 2 is primarily recreational, with some areas accessible to construction barges depending on seasonal flows. The Sacramento River is considered a navigable water from its mouth through the extent of the program area. The Feather River is considered a navigable water from its confluence with the Sacramento River to the railroad bridge that crosses it in Marysville.

Region 3

Levees in Region 3 are located in parts of Colusa, Glenn, Butte, and Tehama Counties. Roads adjacent to the levees in the program area are primarily two-lane county roads, two-lane highways, or access roads. Highways adjacent to the levees in Region 3, or that may be used as haul routes, include SR 45, SR 162, SR 32, SR 99, and SR 99W. SR 45, SR 162, SR 32, and SR 99W are two-lane highways in areas where they run adjacent to or cross SRBPP levees. SR 99 is a four-lane highway where it crosses SRBPP levees, and would also be used as a haul route for construction equipment and materials. I-5 is not located adjacent to SRBPP levees in Region 3 but could be used as a haul route. While it is not currently known where specific project sites will be located, local roads that could provide hauling access to large sections of SRBPP levees in Region 3 include River Road and Ord Ferry Road.

Navigation in Region 3 is primarily recreational. Seasonal flows limit navigation in the region; however, some areas may be accessible by construction barge depending on water levels. The portions of the Sacramento River that lie within Region 3 are considered navigable waters.

Regulatory Setting

Appendix C, *Regulatory Background*, describes the federal, state, and local laws, regulations, and policies that pertain to transportation and navigation within the program area. The pertinent laws, regulations, and policies are listed below.

- Federal:
  - National Environmental Policy Act
  - River and Harbors Appropriation Act of 1899
- State:
  - California Environmental Quality Act
  - California Department of Transportation standards
- Local:
  - Butte County General Plan

- Colusa County General Plan
- Glenn County General Plan
- Placer County General Plan
- Sacramento County General Plan
- Sutter County General Plan
- Tehama County General Plan
- Yolo County General Plan
- Yuba County General Plan

Determination of Effects

This section describes the analysis of effects relating to transportation and navigation for the proposed program. It describes the methods used to determine the effects of the proposed program and lists the thresholds used to conclude whether an effect would be significant. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant effects accompany the discussion of each effect. How effects differ among reaches is discussed as applicable.

Assessment Methods

The proposed program comprises the construction of levee improvements along multiple separate reaches throughout Regions 1a, 1b, 2, and 3. Because of the earthwork involved and the need for materials deliveries, construction would intermittently generate substantial volumes of traffic. Once the construction is completed, maintenance needs would be very limited. Analysis of traffic effects, therefore, concentrates on the construction of levee improvements.

For the purposes of analysis, the effects of these proposed program activities were divided into two impact mechanism categories: (1) truck and worker trip effects on roadway operation and circulation, and (2) temporary partial obstructions in navigable waterways from barge trips and waterside levee construction activities.

Because of uncertainties of erosion site location from year to year, the uncertain timing and extent of linear footage of work to be constructed, and the short-term duration of construction at any particular site , no quantitative level of service analysis was performed. Quantitative information (truck trips, treatment location, and number of workers) will be developed at a project-level as individual projects are proposed and analyzed.

Significance Criteria

For this analysis, a transportation effect was considered significant if it would result in any of the following outcomes, which are based on professional practice, State CEQA Guidelines Appendix G, and general plan policies of the counties involved:

- cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections);

- cause, either individually or cumulatively, exceedance of a level-of-service (LOS) standard established by the counties and/or Caltrans for designated roads or highways;
- substantially alter present patterns of circulation or movement;
- substantially increase hazards because of a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., slow-moving vehicles);
- result in inadequate emergency access;
- result in inadequate parking capacity;
- conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks); or
- substantially impede navigation of watercraft as a result of the staging of barges within navigable sections of the surrounding waterways.

Although some of the proposed levee improvements would take place near the Sacramento International Airport, the proposed improvements in these areas would be restricted to levee improvements and related construction activity, and implementation of the proposed program would not alter traffic patterns or result in substantial safety risks associated with airport operations. Effects on air transportation and circulation are not addressed further in this chapter.

Effects and Mitigation Measures

Alternative 1—No Action

Under the No Action Alternative, there would be no change in the characteristics of the regional transportation system, local roadways, or navigation in and around the program area as a result of this proposed program. It is likely that the levee roads and other roads in the program area would continue to be maintained by the various cities, counties, and state agencies responsible for roads adjacent to SRBPP levees. No road modifications, including the raising and building of new roads, would result as part of the proposed program, and navigation would not change under the No Action Alternative. However, if the levees are not fixed, it is possible that breaching could occur, which could severely damage or destroy roadways near the levees and cause inundation of nearby roadways. This type of levee failure could potentially result in a significant effect on traffic and circulation, and limit the transport of people and goods through the program area.

Alternative 2A—Low Maintenance

Effect TN-1: Temporary Increase in Traffic Volumes from Construction-Generated Traffic and Potential Degradation of LOS for Roadways in the Vicinity of the Program

Implementation of Alternative 2A would require hauling of construction equipment and materials along highways and local roads that provide access to SRBPP levees. The construction schedule, exact treatment location, number of required workers, and number of trucks have not been determined at this time. The roadways used by construction traffic would vary, depending on the specific construction site. Nonetheless, the trucks and workers required would temporarily increase the daily and peak hour traffic along specified routes and could potentially worsen the traffic operation along these roadways, particularly if numerous trips are made during the morning or afternoon peak traffic periods. Traffic levels would return to normal levels once construction is completed. However, this effect would still be considered significant during construction. Implementation of Mitigation Measure TN-MM-1 would reduce this effect to less than significant.

Mitigation Measure TN-MM-1: Implement a Traffic Control and Road Maintenance Plan

A traffic control plan describes the methods of traffic control to be used during construction. All on-street construction traffic will be required to comply with the local jurisdiction's standard construction specifications. The plan will minimize the effects of construction on the roadway system in the program area throughout the construction period. Construction contractors will follow the standard construction specifications of affected jurisdictions and obtain the appropriate encroachment permits, if required. The conditions of the encroachment permit will be incorporated into the construction contract and the permit will be enforced by the issuing agency.

Proposed lane closures during the morning and evening commuting hours will be coordinated with the appropriate jurisdiction and minimized during the morning and evening peak traffic periods. Standard construction specifications also typically limit lane closures during commuting hours. Lane closures will be kept as short as possible. If a road must be closed, detour routes and/or temporary roads will be made to accommodate traffic flows. Detour signs will be provided to direct traffic through detours. Advance notice signs of upcoming construction activities will be posted at least 1 week in advance so that motorists are able to avoid traveling through the program area during these times.

Safe pedestrian and bicyclist access, if any exists on the current roadway, will be maintained in or around the construction areas, to the extent feasible. Construction areas will be secured as required by the applicable jurisdiction to prevent pedestrians and bicyclists from entering the work site, and all stationary equipment will be located as far away as possible from areas where bicyclists and pedestrians are present.

The construction contractor will notify and consult with emergency service providers to maintain emergency access and facilitate the passage of emergency vehicles on city streets.

The construction contractor will provide adequate parking for construction trucks, equipment, and construction workers within the designated staging areas throughout the construction period. If inadequate space for parking is available at a given work site, the construction contractor will provide an off-site staging area and, as needed, coordinate the daily transport of construction vehicles, equipment, and personnel to and from the work site.

The construction contractor will assess damage to roadways used during construction and will repair all potholes, fractures, and other damages.

Effect TN-2: Potential Increase in Safety Hazards Attributable to Construction-Generated Traffic

The maneuvering of construction-related vehicles and equipment among the general purpose traffic on local roads could cause safety hazards. However, implementation of Mitigation Measure TN-MM-1 would minimize construction-related traffic hazards, and would reduce this effect to less than significant.

Effect TN-3: Increase Emergency Response Times

Emergency access to the program area could be affected by construction of the proposed program, and construction-related traffic could delay or obstruct the movement of emergency vehicles. However, implementation of Mitigation Measure TN-MM-1 would minimize construction-related traffic hazards, and would reduce this effect to less than significant.

Effect TN-4: Potential Inadequate Parking Supply to Meet Parking Demand for Construction Equipment and Construction Workers

A parking area for construction workers and trucks would be provided at staging areas adjacent to a work site or areas within the levee right-of-way; therefore, there would be no effect related to inadequate parking.

Effect TN-5: Potential Conflict with Alternative Transportation Modes because of Temporary Road Closures

Although most of the construction of the proposed program would take place within the SRBPP right-of-way, temporary road closures might be needed in some areas, which could interfere with transit services or bicycle travel along these roads. However, implementation of Mitigation Measure TN-MM-1 would minimize construction-related traffic hazards, and would reduce this effect to less than significant.

Effect TN-6: Temporary Changes to Navigation

Implementation of this alternative could require in-water work that could cause temporary reduction in navigability in waters within the program area. Construction barges may be used for the hauling and placing of rock slope protection, which would decrease available space for navigation along the various water bodies within the program area. Water body widths vary greatly throughout the program area, and because construction locations have not yet been determined, it is not definitively known whether the use of barges would obstruct navigation within the program area. For example, areas such as the Sacramento River in the southern portion of the program area are wide enough to accommodate barges without impeding navigation. Other areas involving levees in the northern sections of the program area would only impede recreational watercraft because the waterways in this area cannot accommodate commercial vessels.

Although navigation may slow on water bodies within the program area during in-water work, construction activities would never completely obstruct navigation, and commercial vessels and recreational watercraft would have the ability to move around the barges. Additionally, to minimize construction-related effects on navigation and increase safety along program waterways, warning signs and buoys would be posted at, upstream of, and downstream of all construction equipment, sites, and activities by the Corps' contractor in accordance with the Federal Regulations Concerning Private Aids to Navigation (33 CFR Section 86). Navigation would return to normal following completion of in-water work.

This effect is considered less than significant because in-water construction would not substantially impede navigation of watercraft as a result of the staging of barges within navigable sections of the surrounding waterways, and implementation of appropriate warning signs and buoys would minimize effects on navigation and increase safety along program waterways.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effects associated with Alternative 3A would be comparable in type, but of a greater magnitude, to those described above for Alternative 2A. The setback levee and adjacent levee treatments would involve additional construction equipment and vehicles, as well as increased hauling of materials. This increase in trips and vehicles could reduce LOS on local transportation systems even lower than Alternative 2A, although the effects involved would be temporary as they would only occur during construction. Effects TN-1 through TN-6 would apply to Alternative 3A; however, as explained above under Alternative 2A, only Effects TN-1, TN-2, TN-3, and TN-5 would be considered potentially significant. Implementation of Mitigation Measure TN-MM-1 described above, would aid traffic circulation and navigation during the construction period, and would reduce these effects to less than significant. Additionally, habitat expansion is an important consideration near the Sacramento International Airport. However, because of the ongoing and proposed type of flood control work to be completed under the Natomas Landside Improvement Project, as well as the application of adjacent levee bank protection measures within the vicinity of the airport under this alternative (Table 2-2), there would not be an expansion of habitat attracting wildlife. The flood control work in the vicinity of the airport, including the proposed program, would preserve and/or replace existing habitat rather than substantially increase habitat.

Effect TN-7: Potential Rerouting of Roads

Implementation of a combination of setback levees and adjacent levees under Alternative 3A would require extensive earthmoving that would potentially include existing levee material. In many parts of the program area, roads run on top of the levee crown or adjacent to it. Construction of a setback levee or adjacent levee may necessitate the removal of these roads. Additionally, in the case of the setback levees, some roads may end up within the floodplain created between the new levee and the old one. These roads may need to be removed as well. Roads to be removed or that would no longer be accessible would be reconstructed outside of the floodplain, and would maintain the routing and circulation capacity of the original roads following construction completion. While some roads would not be removed until new roadways are completed in order to maintain circulation, in some cases it may be necessary to remove roads before or during construction of the setback levee so the existing levee can be used as a borrow site, which would reduce hauling trips but would also reduce circulation. Therefore, this effect is considered potentially significant. Implementation of Mitigation Measure TN-MM-1 would reduce this effect to less than significant, because detour routes would be provided as part of the mitigation measure.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effects associated with Alternative 4A would be comparable in type, but of a lesser magnitude, to those described above for Alternative 3A, but greater than those described under Alternative 2A. The setback levee and adjacent levee treatments would involve additional construction equipment and vehicles, as well as increased hauling of materials compared with Alternative 2A. However, there would be fewer setback levees and adjacent levees constructed under Alternative 4A than there would be under Alternative 3A, and, therefore, the extent of the effects related to increases in truck trips and vehicles would not be as great. These effects would be temporary as they would only occur during construction. Effects TN-1 through TN-7 would apply to Alternative 4A; however, only Effects TN-1, TN-2, TN-3, TN-5, and TN-7 would be considered potentially significant, as explained above under Alternative 2A (for Effects TN-1 through TN-6) and Alternative 3A (for Effect TN-7). Implementation of Mitigation Measure TN-MM-1 described above under Alternative 2A would aid traffic circulation and navigation during the construction period, and would reduce these effects to less than significant.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effects associated with Alternative 5A would be comparable in type, but of a lesser magnitude, to those described above for Alternative 3A, but greater than those described under Alternative 2A. The setback levee and adjacent levee treatments would involve additional construction equipment and vehicles, as well as increased hauling of materials compared with Alternative 2A. However, there would be fewer setback levees and adjacent levees constructed under Alternative 5A than there would be under Alternative 3A, and, therefore, the extent of the effects related to increases in truck trips and vehicles would not be as great. These effects would be temporary as they would only occur during construction. Effects TN-1 through TN-7 would apply to Alternative 5A; however, only Effects TN-1, TN-2, TN-3, TN-5, and TN-7 would be considered potentially significant, as explained above under Alternative 2A (for Effects TN-1 through TN-6) and Alternative 3A (for Effect TN-7). Implementation of Mitigation Measure TN-MM-1 described above under Alternative 2A would aid traffic circulation and navigation during the construction period, and would reduce these effects to less than significant.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effects associated with Alternative 6A would be comparable in type, but of a lesser magnitude, to those described above for Alternative 3A, but greater than those described under Alternative 2A. The setback levee treatment would involve additional construction equipment and vehicles, as well as increased hauling of materials compared with Alternative 2A. However, there would be fewer setback levees constructed under Alternative 6A than there would be under Alternative 3A, and, therefore, the extent of the effects related to increases in truck trips and vehicles would not be as great. These effects would be temporary as they would only occur during construction. Effects TN-1 through TN-7 would apply to Alternative 6A; however, only Effects TN-1, TN-2, TN-3, TN-5, and TN-7 would be considered potentially significant, as explained above under Alternative 2A (for Effects TN-1 through TN-6) and Alternative 3A (for Effect TN-7). Implementation of Mitigation Measure TN-MM-1 described above under Alternative 2A would aid traffic circulation and navigation during the construction period, and would reduce these effects to less than significant.

Chapter 8

Air Quality and Climate Change

Introduction and Summary

This chapter describes the environmental setting associated with air quality and climate change, the determination of environmental effects on air quality and climate change that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- Indirect Source Review Guidelines (Feather River Air Quality Management District 2010).
- Air Resources Board (ARB) Air Quality Databases: Aerometric Data Analysis and Management System (ADAM) (California Air Resources Board 2012a).
- Area Designation Maps/State and National (California Air Resources Board 2012b).
- Bay Area Air Quality Management District CEQA Guidelines (Bay Area Air Quality Management District 2012).
- CEQA Air Quality Handbook: Guidelines for Assessing Air Quality Impacts for Projects Subject to CEQA Review (Butte County Air Quality Management District 2008).
- Guide to Assessing Air Quality in Sacramento County (Sacramento Metropolitan Air Quality Management District 2011).
- Green Book (U.S. Environmental Protection Agency 2012a).
- Handbook for Assessing and Mitigating Air Quality Impact (Yolo-Solano Air Quality Management District 2007).

Table 8-1 summarizes the air quality and climate change effects resulting from the implementation of the program alternatives.

Table 8-1. Summary of Air Quality and Climate Change Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels	AQ-MM-1a: Apply Applicable Air District's Mitigation Measures to Reduce Construction Emissions below *de minimis* Threshold Levels AQ-MM-1b: Offset Construction-Generated NO_X Emissions to Net Zero (0) for NO_X Emissions in Excess of *de minimis* Thresholds	Before and during construction

Effect	Mitigation Measures	Implementation Period
AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels	AQ-MM-2: Apply Applicable Air District's Mitigation Measures to Reduce Operational Emissions below Federal *de minimis* Thresholds	During post-project operational activities
AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards	AQ-MM-3: Apply Applicable Air District's Mitigation Measures to Reduce Construction Emissions below Applicable Air District's Thresholds	Before and during construction
AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related HAPs/TACs	AQ-MM-4: Apply Applicable Air District's Mitigation Measures to Reduce HAP/TAC Emissions below the Applicable Air District's HAP/TAC Thresholds	Before and during construction
AQ-5: Generation of Operational Emissions in Excess of Applicable Standards	AQ-MM-5: Apply Applicable Air District's Mitigation Measures to Reduce Operational Emissions below Applicable Air District's Thresholds	During post-project operational activities
AQ-6: Generation of Construction GHG Emissions that May Have a Significant Impact on the Environment	AQ-MM-6: Implement Measures to Minimize GHG Emissions from Construction Activities	Before and during construction
AQ-7: Generation of Operational GHG Emissions that May Have a Significant Impact on the Environment	AQ-MM-6: Implement Measures to Minimize GHG Emissions from Construction Activities	During post-project operational activities

Environmental Setting

Existing Conditions

The program area is located along the Sacramento River and its tributaries and spans Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties. These counties (or portions of some counties) fall under jurisdiction of the following air districts.

- Bay Area Air Quality Management District (BAAQMD): The portion of Solano County west of the Coast Ranges.
- Butte County Air Quality Management District (BCAQMD): Butte County.
- Colusa County Air Pollution Control District (CCAPCD): Colusa County.
- Feather River Air Quality Management District (FRAQMD): Sutter and Yuba Counties.
- Glenn County Air Pollution Control District (GCAPCD): Glenn County.
- Placer County Air Pollution Control District (PCAPCD): Placer County.
- Sacramento Metropolitan Air Quality Management District (SMAQMD): Sacramento County.

- Tehama County Air Pollution Control District (TCAPCD): Tehama County.
- Yolo-Solano Air Quality Management District (YSAQMD): Yolo County and the portion of Solano County east of the Coast Ranges.

In addition, these air districts are divided into two air basins, which are discussed in more detail below. All of the air districts, except for the BAAQMD, are located within the Sacramento Valley Air Basin (SVAB). The BAAQMD shares its boundaries with the San Francisco Bay Area Air Basin (SFBAAB).

Regional Climate and Meteorology

Although the primary factors that determine air quality are the locations of air pollutant sources and the amount of pollutants emitted from those sources, meteorological conditions and topography are also important factors—atmospheric conditions, such as wind speed, wind direction, and air temperature gradients, interact with the physical features of the landscape to determine the movement and dispersal of air pollutants. A large majority of construction at the identified erosion sites would occur within the SVAB, and a very small portion of construction would occur in the SFBAAB.

Sacramento Valley Air Basin

The SVAB is surrounded by the Coast Ranges on the west and by the Sierra Nevada range on the east. The Carquinez Strait is a sea-level gap in the Coast Ranges located approximately 50 miles southwest of Sacramento. Marine breezes through the Carquinez Strait result in a predominantly southwesterly wind direction in the SVAB. Sea breezes lessen in the winter, and northerly winds occur more frequently, but southerly winds are still predominant (Parus Consulting and Ayres Associates 2008).

Storms are diverted north, away from California, during the spring, summer, and early fall by a comparatively stable high pressure weather system off the coast. During this time, there are frequent subsidence inversions (warm air over cooler air) in the region. Subsidence inversions, along with strong sunlight, combine to produce smog, of which ozone is the main component. In addition to this high-pressure zone, a thermal trough is frequently positioned over the Central Valley. A thermal trough is a low-pressure zone caused by intense surface heating. The relative positions of the pressure zones help increase the movement of cool ocean air through the Carquinez Strait into the Sacramento Valley. This helps cool the region, but it also carries pollutants from upwind sources (Parus Consulting and Ayres Associates 2008). During the summertime (July), the average high temperature in the region is 94°F, and the average low temperature is 61°F. The average high precipitation during this period is 0.05 inches (The Weather Channel 2009a).

The position of the summertime high-pressure system shifts to the south during the late fall, winter, and early spring, which allows storm fronts to move through the region. These storms account for a large majority of precipitation in the region (Parus Consulting and Ayres Associates 2008). Wintertime (January) average precipitation in the SVAB is 4.18 inches. Average wintertime temperatures range from a low of 41°F to a high of 55°F (The Weather Channel 2009a). Periods of stagnation occur between storms. During these periods, there are very light winds, which allow surface inversions to form (Parus Consulting and Ayres Associates 2008).

San Francisco Bay Area Air Basin

Bay area topography consists of coastal mountain ranges, inland valleys, and bays. The parts of the program area in the SFBAAB are in Solano County. It is in the Carquinez Strait subregion of the SFBAAB (Bay Area Air Quality Management District 2012).

The Carquinez Strait is the only sea-level gap between the San Francisco Bay and the Central Valley. Prevailing winds originate from the west, particularly during the summer and fall months high offshore pressure, combined with low pressure in the Central Valley, cause marine air to flow eastward through the Carquinez Strait. Winds are strongest in the afternoon, and afternoon wind speeds of 15 to 20 mph are common throughout the region. Annual average wind speeds range from 8 mph in Martinez to 10 mph further east. During the summer and fall months, this can cause elevated pollutant levels to move into the central Bay Area. These high-pressure periods are usually accompanied by low wind speeds, shallow mixing depths, higher temperatures, and little or no rainfall. (Bay Area Air Quality Management District 2012).

Annual average wintertime (January) temperatures in the Carquinez Strait region range from a low of 39°F to a high of 54°F, and the average precipitation is 4.25 inches. Annual average summertime (July) temperatures in the region range from a low of 55°F to a high of 87°F, and the average precipitation is 0.02 inches (The Weather Channel 2009b).

Criteria Pollutants

The federal and state governments have established ambient air quality standards for the following six criteria pollutants: ozone, CO, NO_2, SO_2, particulate matter (particulate matter smaller than 10 microns or less in diameter [PM10] and particulate matter smaller than 2.5 microns or less in diameter [PM2.5]), and lead. Ozone, NO_2, and particulate matter are generally considered to be “regional” pollutants, as these pollutants or their precursors affect air quality on a regional scale. Pollutants such as CO, SO_2, lead, and particulate matter are considered to be local pollutants that tend to accumulate in the air locally. Particulate matter is considered to be a localized pollutant as well as a regional pollutant. Within the program area, ozone, PM10, and PM2.5 are considered pollutants of concern. TACs are also discussed below, although no state or federal ambient air quality standards exist for these pollutants. Brief descriptions of these pollutants are provided below, and a complete summary of California and national ambient air quality standards (CAAQS and NAAQS, respectively) is provided in Table 8-2.

Ozone

Ozone is a respiratory irritant that increases susceptibility to respiratory infections. It is also an oxidant that can cause substantial damage to vegetation and other materials.

Ozone is not emitted directly into the air but is formed by a photochemical reaction in the atmosphere. Ozone precursors (reactive organic gases [ROG] and nitrogen oxides [NO_X]) react in the atmosphere in the presence of sunlight to form ozone. Because photochemical reaction rates depend on the intensity of ultraviolet light and air temperature, ozone is primarily a summer air pollution problem.

State and federal standards for ozone have been set for 1- and 8-hour averaging times. The state 1-hour ozone standard is 0.09 parts per million (ppm), not to be exceeded. The Environmental Protection Agency (EPA) in 2005 replaced the 1-hour ozone standard with an 8-hour standard of 0.075 ppm. However, the California 1-hour standard will remain in effect. The state 8-hour standard is 0.070 ppm, not to be exceeded.

1 **Table 8-2. National and California Ambient Air Quality Standards**

Pollutant	Symbol	Average Time	Standard (ppm) California	Standard (ppm) National	Standard (μg/m³) California	Standard (μg/m³) National	California Violation Criteria	National Violation Criteria
Ozone	O_3	1 hour	0.09	–	180	–	If exceeded	–
		8 hours	0.070	0.075	137	147	If exceeded	If fourth-highest 8-hour concentration in a year, averaged over 3 years, is exceeded at each monitor in an area
Carbon monoxide	CO	8 hours	9.0	9	10,000	10,000	If exceeded	If exceeded on more than 1 day per year
		1 hour	20	35	23,000	40,000	If exceeded	If exceeded on more than 1 day per year
Inhalable particulate matter	PM10	Annual arithmetic mean	–	–	20	–	If exceeded	–
		24 hours	–	–	50	150	If exceeded	If the expected number of days per calendar year with a 24-hour average concentration above 150 μg/m³ is equal to or less than one.
	PM2.5	Annual arithmetic mean	–	–	12	15	If exceeded	If 3-year average from single or multiple community-oriented monitors is exceeded
		24 hours	–	–	–	35	–	If 3-year average of 98th percentile at each population-oriented monitor in an area is exceeded
Nitrogen dioxide	NO_2	Annual arithmetic mean	0.030	0.053	57	100	If exceeded	If exceeded
		1 hour	0.18	0.100	339	188	If exceeded	If exceeded on more than 1 day per year
Sulfur dioxide	SO_2	Annual arithmetic mean	–	0.030**	–	–	–	If exceeded
		24 hours	0.04	0.014**	105	–	If exceeded	If exceeded on more than 1 day per year
		3 hour	0.50*	–	1,300*	–	–	–
		1 hour	0.25	0.075	655	196	If exceeded	If 3-year average of the annual 99th percentile of 1-hour daily maximum concentration exceed.
Lead particles	Pb	Calendar quarter	–	–	–	1.5**	–	If exceeded no more than 1 day per year
		30-day average	–	–	1.5	–	If equaled or exceeded	–
		Rolling 3-month average	–	–	–	0.15		Averaged over a rolling 3-month period

Source: California Air Resources Board 2012c.
* = secondary standard; ** = for certain areas; ppm = parts per million; μg/m³= micrograms per cubic meter.

Carbon Monoxide

CO is a public health concern because it combines readily with hemoglobin and reduces the amount of oxygen transported in the bloodstream. CO can cause health problems such as fatigue, headache, confusion, dizziness, and even death.

Motor vehicles are the dominant source of CO emissions in most areas. High CO levels develop primarily during winter when periods of light winds combine with the formation of ground-level temperature inversions (typically from the evening through early morning). These conditions result in reduced dispersion of vehicle emissions. Motor vehicles also exhibit increased CO emission rates at low air temperatures.

State and federal CO standards have been set for 1- and 8-hour averaging times. The state 1-hour standard is 20 ppm, not to be exceeded, whereas the federal 1-hour standard is 35 ppm, not to be exceeded more than 1 day per year. The state 8-hour standard is 9.0 ppm, while the federal standard is 9 ppm. This means that a monitored 8-hour CO concentration from 9.1 to 9.4 ppm violates the state but not the federal standard.

Inhalable Particulates

Particulates can damage human health and retard plant growth. Health concerns associated with suspended particulate matter focus on those particles small enough to reach the lungs when inhaled. Particulates also reduce visibility and corrode materials. Particulate emissions are generated by a wide variety of sources, including agricultural activities, industrial operations, vehicles (e.g., dust suspended by vehicle traffic and construction equipment), and secondary aerosols (formed by reactions in the atmosphere).

The federal and state ambient air quality standard for particulate matter applies to two classes of particulates: PM10 and PM2.5. The state PM10 standards are 50 $\mu g/m^3$ as a 24-hour average and 20 $\mu g/m^3$ as an annual arithmetic mean. The federal PM10 standard is 150 $\mu g/m^3$ as a 24-hour average. For PM2.5, the state has adopted a standard of 12 $\mu g/m^3$ for the annual arithmetic mean. The federal PM2.5 standards are 35 $\mu g/m^3$ for the 24-hour average and 15.0 $\mu g/m^3$ for the annual arithmetic mean.

Nitrogen Dioxide

Nitrogen oxides (NO_X) are a family of highly reactive gases that are primary precursors to the formation of ground-level ozone, reacting in the atmosphere to form acid rain. NO_X, a mixture of NO and NO_2, are produced from natural sources, motor vehicles, and other fuel combustion processes. NO is colorless and odorless and is in the atmosphere to form NO_2. NO_2 is an odorous, brown, acidic, highly corrosive gas that can affect human health and environment. s NO_X are critical components of photochemical smog. NO_2 produces the yellowish-brown color of the smog.

NO_X can irritate the lungs, cause lung damage, and lower resistance to respiratory infections such as influenza. The effects of short-term exposure are still unclear, but continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children. Health effects associated with NO_X are an increase in the incidence of chronic bronchitis and lung irritation. Chronic exposure to NO_2 may lead to eye and mucus membrane aggravation along with pulmonary dysfunction. NO_X can cause fading of textile dyes and additives, deterioration of cotton and nylon, and corrosion of metals due to the production of particulate nitrates. Airborne NO_X can impair visibility.

NO_X is a major component of acid deposition in California. NO_X may affect both terrestrial and aquatic ecosystems. NO_X in the air is a potentially significant contributor to a number of environmental effects, such as acid rain and eutrophication in coastal waters. Eutrophication occurs when a body of water suffers an increase in nutrients that reduces the amount of oxygen in the water, producing an environment that is destructive to fish and other animal life.

The ARB and the EPA have set CAAQS and NAAQS standards, respectively, for NO_2 but not for NO. The state NO_2 standards are 0.030 ppm as an annual arithmetic mean and 0.18 ppm as a 1-hour standard, not to be exceeded. The federal NO_2 standard is 0.053 ppm as an annual arithmetic mean, not to be exceeded more than one day per year.

Sulfur Dioxide

Sulfur Oxides (SO_X) gases are a family of colorless, pungent gases, which include SO_2 and are formed primarily by combustion of sulfur-containing fossil fuels (mainly coal and oil), metal smelting, and other industrial processes. SO_X can react to form sulfates, which significantly reduce visibility. SO_X is a precursor to particulate matter formation.

The major health concerns associated with exposure to high concentrations of SO_X include effects related to breathing, respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Major subgroups of the population that are most sensitive to SO_X include individuals with cardiovascular disease or chronic lung disease (such as bronchitis or emphysema), as well as children and the elderly. SO_X emissions can also damage tree foliage and agricultural crops. Together, SO_X and NO_X are the major precursors to acid rain, which is associated with the acidification of lakes and streams and accelerated corrosion of buildings and monuments.

The ARB and the EPA have set CAAQS and NAAQS standards for SO_2. The state standards are 0.04 ppm as a 24-hour average and 0.25 ppm as a 1-hour average, not to be exceeded. The federal standards are 0.030 ppm as an annual arithmetic mean, not to be exceeded, and 0.14 ppm as a 24-hour average, not to be exceeded more than one day per year.

Lead

Lead is a natural constituent of air, water, and the biosphere. Lead is neither created nor destroyed in the environment, so it essentially persists forever. Several decades ago lead was used as an automotive fuel additive to increase the octane rating. Because gasoline-powered automobile engines were a major source of airborne lead through the use of leaded fuels, and the use of leaded fuel has been mostly phased out, the ambient concentrations of lead have dropped dramatically.

Short-term exposure to high levels of lead can cause vomiting, diarrhea, convulsions, coma, or even death. However, even small amounts of lead can be harmful, especially to infants, young children, and pregnant women. Symptoms of long-term exposure to lower lead levels may be less noticeable but are still serious. Anemia is common, and damage to the nervous system may cause impaired mental function. Other symptoms are appetite loss, abdominal pain, constipation, fatigue, sleeplessness, irritability, and headache. Continued excessive exposure, as in an industrial setting, can affect the kidneys.

Lead exposure is most serious for young children because they absorb lead more easily than adults and are more susceptible to its harmful effects. Even low-level exposure may harm the intellectual development, behavior, size, and hearing of infants. Mothers with high levels of lead in their bodies can expose their developing fetuses, resulting in serious and developmental problems including low birth weight and slowed postnatal neurobehavioral development.

The state standard for lead is 1.5 $\mu g/m^3$ as a 30-day average, not to be equaled or exceeded. The federal standards are 1.5 $\mu g/m^3$ averaged over a calendar quarter, not to be exceeded more than one day per year, and 0.15 $\mu g/m^3$ as a rolling 3-month average, not to be exceeded over a 3-month period.

Greenhouse Gases and Climate Change

The phenomenon known as the greenhouse effect keeps the earth's atmosphere near the surface warm enough for the successful habitation by humans and other forms of life. Greenhouse gases (GHGs) present in the earth's lower atmosphere play a critical role in maintaining the earth's temperature as they trap some of the long-wave infrared radiation emitted from the earth's surface that otherwise would have escaped to space.

The accelerated increase of fossil fuel combustion and deforestation since the industrial revolution of the 19th century has exponentially increased concentrations of GHGs in the atmosphere. Increases in the atmospheric concentrations of GHGs in excess of natural ambient concentrations increase the natural greenhouse effect.

This increased greenhouse effect has contributed to global warming, which is an increased rate of warming of the earth's surface temperature. Specifically, increases in GHGs lead to increased absorption of long-wave infrared radiation by the earth's atmosphere and further warm the lower atmosphere, thereby increasing evaporation rates and temperatures near the surface. Warming of the earth's lower atmosphere induces large-scale changes in ocean circulation patterns, precipitation patterns, global ice cover, biological distributions, and other changes to the earth system that are collectively referred to as climate change.

The Intergovernmental Panel on Climate Change (IPCC) has been established by the World Meteorological Organization and United Nations Environment Programme to assess scientific, technical, and socioeconomic information relevant to the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The IPCC estimates that the average global temperature rise between the years 2000 and 2100 could range from 1.1°C, with no increase in GHG emissions above year 2000 levels, to 6.4°C, with substantial increase in GHG emissions (Rogner et al. 2007). Large increases in global temperatures could have massive deleterious impacts on the natural and human environments.

Principal Greenhouse Gases

GHGs are gases that trap heat in the atmosphere. GHGs are both naturally occurring and artificial. Examples of GHGs that are produced both by natural processes and industry are carbon dioxide (CO_2), Methane (CH_4), and Nitrous oxide (N_2O). Examples of GHGs created and emitted primarily through human activities are hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The primary GHGs generated by the proposed program—CO_2, CH_4, and N_2O—are discussed below.

The IPCC estimates that CO_2 accounts for more than 75% of all anthropogenic (human-made) GHG emissions. Three-quarters of anthropogenic CO_2 emissions are the result of fossil fuel burning, and approximately one-quarter result from land use change (Rogner et al. 2007). CH_4 is the second largest contributor of anthropogenic GHG emissions and is the result of growing rice, raising cattle, combustion, and mining coal (National Oceanic and Atmospheric Administration 2005). N_2O, while not as abundant as CO_2 or CH_4, it is a powerful GHG. Sources of N_2O include agricultural processes, nylon production, fuel-fired power plants, nitric acid production, and vehicle emissions.

In order to simplify reporting and analysis, methods have been set forth to describe emissions of GHGs in terms of a single gas. GHG emissions other than CO_2 are commonly converted into carbon dioxide equivalents (CO_2e), which takes into account the differing global warming potential (GWP) of different gases. GWP is a measure of a gas's heat-absorbing capacity and lifespan relative to a reference gas, CO_2 (CO_2 has a GWP of 1 by definition).

Greenhouse Gas Emissions Inventories

A GHG inventory is a quantification of GHG emissions and sinks within a selected physical and/or economic boundary over a specified time. GHG inventories can be performed on a large scale (i.e., for global and national entities) or on a small scale (i.e., for a particular building or person). GHG sinks typically refer to removal of GHGs from the atmosphere as a result of carbon sequestration. Carbon sequestration is the process by which atmospheric CO_2 is absorbed by flora and stored as carbon in biomass, and mostly takes place in tress and forests.

Table 8-3 outlines the most recent global, national, and statewide GHG inventories to help contextualize the magnitude of potential program-related emissions. Worldwide, California is the 14th to 19th largest emitter of GHGs and; nationwide, California is the second largest emitter of GHGs behind Texas (California Air Resources Board 2012d).

Table 8-3. Global, National, and State GHG Emissions Inventories

Emissions Inventory	Total GHG Emissions and Sinks in CO_2e (metric tons)
2004 IPCC Global GHG Emissions Inventory	49,000,000,000
2010 EPA National GHG Emissions Inventory	5,747,100,000
2009 ARB State GHG Emissions Inventory	452,970,000
2005 Sacramento County GHG Emissions Inventory	12,422,425

Sources: Rogner et al. 2007; U.S. Environmental Protection Agency 2012b; California Air Resources Board 2012d; ICF Jones & Stokes 2009.

GHG emissions in California are attributable to human activities associated with industrial/ manufacturing, utilities, transportation, residential, and agricultural sectors, as well as natural processes. Transportation is responsible for 38% of the state's GHG emissions, followed by the industrial sector (20%), electricity generation (23%), agriculture and forestry (7%) and other sources (12%) (California Air Resources Board 2012d).

Climate Change Effects on State Climate Trends

Climate change is a complex phenomenon that has the potential to alter local climatic patterns and meteorology. Although modeling indicates that climate change will result in sea level rise, changes in regional climate and rainfall, and other things, a high degree of scientific uncertainty still exists with regard to characterizing future climate characteristics and predicting how various ecological and social systems will react to any changes in the existing climate at the local level. Regardless of this uncertainty, it is widely understood that some form of climate change is expected to occur in the future.

Several recent studies have attempted to characterize future climatic scenarios for the state. While specific estimates and statistics on the severity of changes vary, sources agree that the San Joaquin Valley and the Delta will witness warmer temperatures, increased heat waves, and changes in rainfall patterns. In addition, reduced snow pack and stream flow in the Sierra Nevada mountains, could lead to changes in water supply into the Delta region. Specifically, the California Energy Commission (CEC) estimates that average annual temperatures in the State will increase by approximately 1°C to 3°C between 2010 and mid-century, according the model for the Sacramento region. Climatic models also predict that between 2035 and 2064, the number of heat wave days modeled for the Sacramento region will increase by more than 100, relative to the previous 30-year period between 2005 and 2034. Annual precipitation may experience a declining trend, but remain highly variable, suggesting that the valley will be vulnerable to increased drought. Warmer temperatures and increased precipitation in the form of rain are expected to result in decreased snowpack in the Sierra Nevada. Such effects will translate into earlier snowmelt and increased potential for flooding as a result of insufficient reservoir capacity to retain earlier snowmelt. (Rogner et al. 2007; California Natural Resources Agency 2009; California Energy Commission 2009)

Sea level rise during the next 50 years is expected to increase dramatically over historical rates. The CEC predicts that by 2050, sea level rise, relative to the 2000 level, will range from 30 centimeters (cm) to 45 cm. Coastal sea level rise could result in saltwater intrusion to the Delta and associated biological impacts in the San Joaquin Valley. Changes in soil moisture and increased risk of wildfires also may dominate future climatic conditions in the program area. (Rogner et al. 2007; California Natural Resources Agency 2009; California Energy Commission 2009).

The changes in temperature, precipitation and sea level may have substantial effects on other resources areas. The primary effects of climate change anticipated in California are listed below (California Natural Resources Agency 2009).

- Increased average temperatures (air, water, and soil).
- Reduced or slightly increased annual precipitation amounts.
- Change from snowfall (and spring snowmelt) to rainfall.
- Decreased Sierra snowpack (earlier runoff, reduced maximum storage).
- Increased evapotranspiration.
- Increased frequency and intensity of Pacific storms (flood events).
- Increased severity of droughts.
- Increased frequency and severity of extreme heat events.
- Increased frequency and severity of wildfire events.
- Sea level rise (with increased salt water intrusion in the Delta).
- Changes in species distribution and ranges.
- Decreased number of species.
- Increased number of vector-borne diseases and pests (including impacts to agriculture).

- Altered timing of animal and plant lifecycles (phenology).
- Disruption of biotic interactions (e.g., predator prey relationships amongst species or increased invasive species abundance).
- Changes in physiological performance, including reproductive success and survival of plants and animals.
- Increase in invasive species.
- Altered migration patterns of fishes, aquatic-breeding amphibians, birds and mammals.
- Changes in food (forage) base.
- Changes in habitat, vegetation structure, and plant and animal communities.

These changes have significant implications for water quality, water supply, flooding, aquatic ecosystems, energy generation, and recreation throughout the state. Guidance documents have been drafted or have been published to discuss strategies to protect resources from climate change in California (e.g., the State of California Sea-Level Rise Interim Guidance Document [Coastal and Ocean Working Group of the California Climate Action Team 2010]).

Toxic Air Contaminants/Hazardous Air Pollutants

Toxic Air Contaminants (TACs) and Hazardous Air Pollutants (HAPs) are pollutants that may result in an increase in mortality or serious illness, or that may pose a present or potential hazard to human health. The Clean Air Act (CAA) identified 188 pollutants as being air toxics. Air toxics are referred to as HAPs under the CAA and are referred to as TACs under the California Clean Air Act (CCAA). Health effects of TACs include cancer, birth defects, neurological damage, damage to the body's natural defense system, and diseases that lead to death. In 1998, following a 10-year scientific assessment process, ARB identified diesel particulate matter (DPM) from diesel-fueled engines as a TAC. In the ARB's *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles,* the ARB said that "Compared to other air toxics CARB has identified and controlled, diesel particulate matter emissions are estimated to be responsible for about 70% of the total ambient air toxics risk" (California Air Resources Board 2000).

Local Area Conditions

Monitoring Data

Existing conditions for air quality in the program area can be further described with summary statistics for criteria air pollutants. Tables 8-4 and 8-5 summarize monitoring data for criteria air pollutant levels from all monitoring stations in the SVAB and SFBAAB, respectively. These numbers represent air quality monitoring data for the last three years (2009–2011) in which complete data are available.

As indicated in Table 8-4, the SVAB has experienced 120 violations of the national 8-hour ozone standard and 23 violations of the national PM2.5 standard during the three-year monitoring period. There were no reported violations of the national 1- and 8-hour CO standards or national PM10 standard. The SVAB has experienced 70 violations of the state 1-hour ozone standard, 170 violations of the state 8-hour ozone standard, and 9 violations of the state PM10 standard during the three-year monitoring period. There have been no violations of the state 1-and 8-hour CO standards.

Table 8-4. Ambient Air Quality Monitoring Data for the Sacramento Valley Air Basin

Pollutant Standards	2009	2010	2011
1-Hour Ozone			
State maximum 1-hour concentration (ppm)	0.122	0.124	0.123
State second-highest 1-hour concentration (ppm)	0.122	0.121	0.118
Number of days standard exceeded[a]			
CAAQS 1-hour (>0.09 ppm)	29	15	26
8-Hour Ozone			
National maximum 8-hour concentration (ppm)	0.104	0.112	0.098
National second-highest 8-hour concentration (ppm)	0.103	0.104	0.097
State maximum 8-hour concentration (ppm)	0.104	0.112	0.098
State second-highest 8-hour concentration (ppm)	0.104	0.104	0.098
Number of days standard exceeded[a]			
NAAQS 8-hour (>0.075 ppm)	45	29	46
CAAQS 8-hour (>0.070 ppm)	65	46	59
Carbon Monoxide (CO)			
Maximum 8-hour concentration (ppm)	2.84	1.89	2.83
Second-highest 8-hour concentration (ppm)	2.84	1.86	2.43
Maximum 1-hour concentration (ppm)	3.3	2.9	3.0
Second-highest 1-hour concentration (ppm)	3.2	2.6	3.0
Number of days standard exceeded[a]			
NAAQS 8-hour (≥9 ppm)	0	0	0
CAAQS 8-hour (≥9.0 ppm)	0	0	0
NAAQS 1-hour (≥35 ppm)	0	0	0
CAAQS 1-hour (≥20 ppm)	0	0	0
Particulate Matter (PM10)[d]			
National[b] maximum 24-hour concentration ($\mu g/m^3$)	76.0	87.4	73.5
National[b] second-highest 24-hour concentration ($\mu g/m^3$)	74.0	49.1	48.5
State[c] maximum 24-hour concentration ($\mu g/m^3$)	76.0	87.4	73.0
State[c] second-highest 24-hour concentration ($\mu g/m^3$)	74.0	49.1	58.0
National annual average concentration ($\mu g/m^3$)	25.6	20.5	24.2
State annual average concentration ($\mu g/m^3$)[e]	26.4	21.0	25.1
Number of days standard exceeded[a]			
NAAQS 24-hour (>150 $\mu g/m^3$)[f]	0	0	0
CAAQS 24-hour (>50 $\mu g/m^3$)[f]	3	2	4
Particulate Matter (PM2.5)			
National[b] maximum 24-hour concentration ($\mu g/m^3$)	49.8	72.2	57.0
National[b] second-highest 24-hour concentration ($\mu g/m^3$)	45.9	33.9	54.3
State[c] maximum 24-hour concentration ($\mu g/m^3$)	71.7	92.3	66.0
State[c] second-highest 24-hour concentration ($\mu g/m^3$)	59.2	43.0	62.8
National 98^{th} percentile of 24-hour concentration	38.7	29.0	46.2
National annual average concentration ($\mu g/m^3$)	10.7	8.8	12.1
State annual average concentration ($\mu g/m^3$) [e]	15.5	10.9	14.6
Number of days standard exceeded[a]			
NAAQS 24-hour (>35 $\mu g/m^3$)	6	1	16

Sources: California Air Resources Board 2012a; U.S. Environmental Protection Agency 2012c.

Notes: CAAQS = California ambient air quality standards.
NAAQS = national ambient air quality standards.
— = insufficient data available to determine the value.

[a] An exceedance is not necessarily a violation.

[b] National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.

[c] State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, State statistics are based on California approved samplers.

[d] Measurements usually are collected every 6 days.

[e] State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

[f] Mathematical estimate of how many days' concentrations would have been measured as higher than the level of the standard had each day been monitored.

Table 8-5. Ambient Air Quality Monitoring Data for the San Francisco Bay Area Air Basin

Pollutant Standards	2009	2010	2011
1-Hour Ozone			
State maximum 1-hour concentration (ppm)	0.113	0.150	0.115
State second-highest 1-hour concentration (ppm)	0.109	0.127	0.099
Number of days standard exceeded[a]			
CAAQS 1-hour (>0.09 ppm)	11	8	5
8-Hour Ozone			
National[b] maximum 8-hour concentration (ppm)	0.094	0.097	0.084
National[b] second-highest 8-hour concentration (ppm)	0.085	0.091	0.079
State[c] maximum 8-hour concentration (ppm)	0.095	0.098	0.085
State[c] second-highest 8-hour concentration (ppm)	0.086	0.092	0.079
Number of days standard exceeded[a]			
NAAQS 8-hour (>0.075 ppm)	8	9	4
CAAQS 8-hour (>0.070 ppm)	13	11	10
Carbon Monoxide (CO)			
Maximum 8-hour concentration (ppm)	2.86	2.19	2.65
Second-highest 8-hour concentration (ppm)	2.50	1.94	2.62
Maximum 1-hour concentration (ppm)	4.6	3.3	4.1
Second-highest 1-hour concentration (ppm)	3.8	3.0	3.7
Number of days standard exceeded[a]			
NAAQS 8-hour (≥9 ppm)	0	0	0
CAAQS 8-hour (≥9.0 ppm)	0	0	0
NAAQS 1-hour (≥35 ppm)	0	0	0
CAAQS 1-hour (≥20 ppm)	0	0	0
Particulate Matter (PM10)[d]			
National[b] maximum 24-hour concentration ($\mu g/m^3$)	51.7	69.1	72.4
National[b] second-highest 24-hour concentration ($\mu g/m^3$)	31.0	45.0	46.8
State[c] maximum 24-hour concentration ($\mu g/m^3$)	55.4	69.6	73.4
State[c] second-highest 24-hour concentration ($\mu g/m^3$)	32.4	46.2	40.0
National annual average concentration ($\mu g/m^3$)	19.5	20.3	19.7
State annual average concentration ($\mu g/m^3$)[e]	20.3	19.5	20.21
Number of days standard exceeded[a]			
NAAQS 24-hour (>150 $\mu g/m^3$)[f]	0	0	0
CAAQS 24-hour (>50 $\mu g/m^3$)[f]	1	4	1
Particulate Matter (PM2.5)			
National[b] maximum 24-hour concentration ($\mu g/m^3$)	45.7	46.5	50.5
National[b] second-highest 24-hour concentration ($\mu g/m^3$)	39.0	45.3	40.3
State[c] maximum 24-hour concentration ($\mu g/m^3$)	49.8	41.5	50.5
State[c] second-highest 24-hour concentration ($\mu g/m^3$)	45.7	36.4	39.7
National 98th percentile of 24-hour concentration	33.5	26.8	30.5
National annual average concentration ($\mu g/m^3$)	10.1	10.5	10.1
State annual average concentration ($\mu g/m^3$) [e]	10.1	9.0	9.9
Number of days standard exceeded[a]			
NAAQS 24-hour (>35 $\mu g/m^3$)	11	6	5

Sources: California Air Resources Board 2012a; U.S. Environmental Protection Agency 2012c.

Notes: CAAQS = California ambient air quality standards.
NAAQS = national ambient air quality standards.

[a] An exceedance is not necessarily a violation.

[b] National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.

[c] State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, State statistics are based on California approved samplers.

[d] Measurements usually are collected every 6 days.

[e] State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

[f] Mathematical estimate of how many days' concentrations would have been measured as higher than the level of the standard had each day been monitored.

As indicated in Table 8-5, the SFBAAB has experienced 21 violations of the national 8-hour ozone standard and 22 violations of the national 24-hour PM2.5 standard over the three-year monitoring period. There have been no violations of the national 1- and 8-hour CO standards or the national PM10 standard. The SFBAAB has experienced 24 violations of the state 1-hour ozone standard, 34 violations of the state 8-hour ozone standard, and 6 violations of the state PM10 standard. There have been no violations of the state 1- and 8-hour CO standards.

Attainment Status

If monitored pollutant concentrations meet state or federal standards over a designated period of time, the area is classified as being in attainment for that pollutant. If monitored pollutant concentrations violate the standards, the area is considered a nonattainment area for that pollutant. If data are insufficient to determine whether a pollutant is violating the standard, the area is designated unclassified. If monitored pollutant concentrations violated the standards in the past but are no longer in violation, the area is considered a maintenance area.

Construction of the proposed program would take place in the following counties: Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba. Table 8-6 summarizes the national and state criteria pollutant attainment status for the counties in the program area.

Table 8-6. Criteria Pollutant Attainment Status in Program Area Counties

County	Pollutant	National	State
Butte	1-hour Ozone	N/A[a]	Moderate Nonattainment
	8-hour Ozone	Marginal Nonattainment[b]	Nonattainment
	CO	Moderate Maintenance	Attainment
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Nonattainment	Nonattainment
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment
Colusa	1-hour Ozone	N/A[a]	Moderate Nonattainment
	8-hour Ozone	Unclassified/Attainment	Nonattainment-Transitional
	CO	Unclassified/Attainment	Unclassified
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Unclassified/Attainment	Attainment
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment
Glenn	1-hour Ozone	N/A[a]	Moderate Nonattainment
	8-hour Ozone	Unclassified/Attainment	Nonattainment
	CO	Unclassified/Attainment	Unclassified
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Unclassified/Attainment	Unclassified
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment

County	Pollutant	National	State
Placer	1-hour Ozone	N/A[a]	Moderate Nonattainment[c]
	8-hour Ozone	Severe Nonattainment	Nonattainment
	CO	Moderate Maintenance	Unclassified/Attainment[d]
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Nonattainment and Unclassified/Attainment[e]	Unclassified/Attainment[d]
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment
Sacramento	1-hour Ozone	N/A[a]	Serious Nonattainment
	8-hour Ozone	Severe Nonattainment	Nonattainment
	CO	Moderate Maintenance	Attainment
	PM10	Moderate Nonattainment	Nonattainment
	PM2.5	Nonattainment	Nonattainment
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment
Solano	1-hour Ozone	N/A[a]	Serious Nonattainment
	8-hour Ozone	Severe/Marginal Nonattainment[f]	Nonattainment
	CO	Moderate Maintenance	Attainment
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Nonattainment	Unclassified
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment
Sutter	1-hour Ozone	N/A[a]	Serious/Moderate Nonattainment[g]
	8-hour Ozone	Unclassified/Attainment and Severe Nonattainment[h]	Nonattainment-Transitional
	CO	Unclassified/Attainment	Attainment
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Nonattainment	Attainment
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment
Tehama	1-hour Ozone	N/A[a]	Moderate Nonattainment
	8-hour Ozone	Unclassified/Attainment	Nonattainment
	CO	Unclassified/Attainment	Unclassified
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Unclassified/Attainment	Unclassified
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment

County	Pollutant	National	State
Yolo	1-hour Ozone	N/A[a]	Serious Nonattainment
	8-hour Ozone	Severe Nonattainment	Nonattainment
	CO	Moderate Maintenance	Attainment
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Nonattainment	Unclassified
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment
Yuba	1-hour Ozone	N/A[a]	Moderate Nonattainment
	8-hour Ozone	Unclassified/Attainment	Nonattainment-Transitional
	CO	Unclassified/Attainment	Unclassified
	PM10	Unclassified/Attainment	Nonattainment
	PM2.5	Nonattainment	Attainment
	SO_2	Unclassified/Attainment	Attainment
	NO_2	Unclassified/Attainment	Attainment
	Pb	Unclassified/Attainment	Attainment

Source: Adapted from: California Air Resources Board 2012b; U.S. Environmental Protection Agency 2012a.

Notes: N/A = Not Available/Applicable

[a] The EPA revoked the 1-hour ozone standard on June 15, 2005.

[b] On June 8, 2007, the United States Court of Appeals vacated the Subpart 1 portion of the Phase 1 Rule. The Subpart 1 areas in the Greenbook are listed as "Former Subpart 1" until reclassification of the areas is finalized. Proposed reclassifications were published on January 16, 2009 (74 FR 2936).

[c] The portion of Placer County in the Mountain Counties Air Basin is nonattainment, and the portion in the SVAB is moderate nonattainment.

[d] The portion of Placer County in the Mountain Counties Air Basin is unclassified, and the portion in the SVAB is in attainment.

[e] The portion of Placer County in the Mountain Counties Air Basin is unclassified/attainment, and the portion in the SVAB is in nonattainment.

[f] The portion of Solano County in the SVAB is designated as severe nonattainment area, and the portion in the SFBAAB is designated as marginal nonattainment.

[g] The north portion of Sutter is moderate nonattainment and the south portion serious nonattainment.

[h] The north portion of Sutter is unclassified/attainment and the south portion is severe nonattainment.

Sensitive Land Uses

Air quality-sensitive land uses are generally defined as locations where sensitive receptors reside. Sensitive receptors are more susceptible to health problems associated with air pollutants (e.g., children and the elderly). Some examples of sensitive land uses include schools, elderly housing, hospitals, and clinics. Land uses in the program area where sensitive receptors may be exposed to increased levels of pollutants during construction activities, include, but are not limited to, residences, schools, and parks that may be located near levees and close to access roads used for haul truck traffic.

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, regional, and local laws, regulations, and policies that pertain to air quality and climate change issues within the program area.

The program area is subject to air quality regulations developed and implemented at the federal, state, and local levels. At the federal level, the EPA is responsible for implementation of the CAA. Some portions of the CAA (e.g., certain mobile-source and other requirements) are enforced directly by EPA. Other portions of the CAA (e.g., stationary-source requirements) are enforced by state and local agencies.

Responsibility for attaining and maintaining air quality in California is divided between the California Air Resources Board (ARB) and regional air quality districts. Areas of control for the regional districts are set by ARB, which divides the state into air basins. These air basins are defined by topography that limits air flow access, or by county boundaries. Plans, policies, and regulations relevant to the proposed program are discussed in Appendix C.

The pertinent laws, regulations, and policies are listed below.

- Federal:
  - National Environmental Quality Act
  - Clean Air Act and National Ambient Air Quality Standards
  - Mandatory Greenhouse Gas Reporting Rule
  - Council on Environmental Quality Draft NEPA Guidance
- State:
  - California Environmental Quality Act
  - California Clean Air Act and California Ambient Air Quality Standards
  - Executive Order S-3-05
  - California Global Warming Solutions Act of 2006
  - ARB Climate Change Scoping Plan
  - CEQA Guidelines
  - Executive Order S-01-07, Low Carbon Fuel Standards
- Local:
  - Bay Area Air Quality Management District standards
  - Butte County Air Quality Management District standards
  - Colusa County Air Pollution Control District standards
  - Feather River Air Quality Management District standards
  - Glenn County Air Pollution Control District standards
  - Placer County Air Pollution Control District standards

- Sacramento Metropolitan Air Quality Management District standards
- Tehama County Air Pollution Control District standards
- Yolo-Solano Air Quality Management District standards

Determination of Effects

This section describes the effect analysis relating to air quality and climate change for the proposed program. It describes the methods used to determine the effects of the proposed program and lists the thresholds used to conclude whether an effect would be significant. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant effects accompany each effect discussion.

Potential air quality effects from the proposed program would result primarily from two activities associated with the proposed program: (1) construction of the proposed program and (2) maintenance workers' vehicle and equipment use (operation) once construction of the program is complete. The effects associated with construction would be short-term, temporary effects, while the effects associated with maintenance workers' activities would also be short term but occur periodically over the life of the project.

Assessment Methods

Construction Emissions

Construction of the proposed program has the potential to generate air quality and GHG emissions through the use of heavy-duty construction equipment in the program area, through vehicle trips related to construction workers traveling to and from the program area, and through the delivery of buttress rock materials to the program area. Different alternatives may utilize different combinations and amounts of construction equipment for different time periods and under different operating conditions. Pollutant emissions are highly dependent on the total amount of disturbed area, the duration of construction, and the intensity of construction activity. Thus, program effects would vary significantly depending on the alternative.

Construction emissions resulting from the proposed program would include ozone precursors (ROG and NO_X), PM10, PM2.5, and GHGs associated with fugitive dust, heavy construction equipment, and construction workers commuting to and from the site. Pollutant emissions would result from the following typical construction activities: (1) demolition and site preparation as needed; (2) grading/cut/fill; (3) construction workers traveling to and from program sites; (4) delivery and hauling of construction supplies and debris to and from program sites; and (5) fuel combustion by on-site construction equipment. These activities may vary by alternative. These construction activities would create temporary emissions of fugitive dust, fumes, equipment exhaust, and other air contaminants. During site preparation, grading, and other earthmoving activities, fugitive emissions of PM10 and PM2.5, as well exhaust emissions, would be the most significant air pollutants generated from construction activities, while exhaust emissions would be primarily associated with other activities.

It is currently unknown the level of activity, scheduling, and activity locations of potential construction activities. Therefore, a quantified analysis of potential construction emissions is not feasible. However, possible construction equipment types associated with implementation of the proposed program are listed below.

- Waterside construction of levee improvements: cranes mounted on barges, excavators, loaders.
- Landside construction of levee improvements: crane system on levee, excavators, bulldozers, loaders, scrapers, haul trucks, and water trucks.

This list of construction equipment is not all-inclusive, and other equipment may be necessary to construct the levee improvements. The assessment of construction air quality and climate change effects considers each of the potential sources noted above. A qualitative assessment of air quality and climate change effects resulting from the alternatives was performed, taking into account the pollutant sources listed below.

- Combustion emissions from construction equipment.
- Combustion emissions from delivery and haul trucks.
- Combustion emissions from construction worker trips.
- Fugitive dust from excavation and rock hauling.
- Fugitive dust from heavy-equipment travel on unpaved areas.

Operational Emissions

Long-term air quality effects are associated with changes in the permanent, continued daily use of the program area. Operational emissions from the proposed program would result from maintenance activities, landscaping activities, and emergency levee repairs. These activities are expected to be sporadic, transitory, and short-term in nature (a few days every month), but the extent of these activities is unknown at this time. Consequently, quantification of operational emissions is not possible at this juncture. Depending upon the alterative, pollutant emissions resulting from the proposed program may increase.

Possible operational emissions resulting from the proposed program would include ozone precursors (ROG and NO_X), PM10, PM2.5, and GHG emissions associated with fugitive dust, heavy equipment, landscaping equipment, and maintenance workers commuting to and from the site. The assessment of operational air quality and climate change effects considers each of these potential sources. It is currently unknown the level of potential operational activities that may result with implementation of the proposed program. Therefore, a quantified analysis of potential construction emissions is not possible, and a qualitative analysis of operational emissions was performed. The qualitative analysis took into account the pollutant sources listed below.

- Combustion emissions from construction equipment.
- Combustion emissions from landscaping equipment.
- Combustion emissions from maintenance worker trips.
- Fugitive dust from heavy-equipment travel on unpaved areas.
- Fugitive dust from landscaping activities.

Hazardous Air Pollutants/Toxic Air Contaminants

Diesel particulate matter (DPM) is the HAP/TAC associated with the proposed program. Emissions of DPM would result from the operation of diesel-powered construction equipment activity during program implementation. A qualitative analysis of HAP/TAC emissions was performed.

Greenhouse Gas Emissions

GHG emissions from program construction and operation would result from fuel usage by onsite equipment, on-road vehicles, and on-water towboats. Certain criteria must be examined to determine if a project will have a significant effect on the environment. However, as of the writing of this report, the agencies with jurisdiction over air quality regulation and GHG emissions, such as EPA, ARB, and the various air districts, have not established quantitative significance thresholds for the assessment of GHG emissions and climate change. Instead, most districts recommend that GHG emissions associated with the project's construction and operational activities be quantified and disclosed using the most up to date calculation and analysis methods. Applicable to the program area, the BAAQMD recommends measures to reduce construction-related GHG emissions, which include the following:

- Alternative-fueled (e.g., biodiesel, electric) construction vehicles/equipment of at least 15 percent of the fleet;
- Local building materials of at least 10 percent; and
- Recycle at least 50 percent of construction waste or demolition materials.

Most districts also recommended that lead agencies include a discussion of feasible construction and operational mitigation necessary to reduce GHG emissions. As discussed in construction and operation emissions sections above, a quantified analysis of potential construction and operation emissions is not possible, and a qualitative analysis of GHG emissions and impacts was performed according to the State CEQA Guidelines.

The Governor's Office of Planning and Research's Amendments to the CEQA Guidelines, which became effective March 18, 2010, indicate that projects should be evaluated based on their cumulative contribution to climate change impacts, and other air quality agencies likewise concur that GHG and climate change should be evaluated as a potentially significant cumulative impact rather than a project-specific impact. Consequently, the proposed program's potential to result in a cumulative increase in GHG contaminant emissions is addressed towards the end of this chapter.

Significance Criteria

NEPA

The NEPA review process must be integrated with other regulatory review processes and consider applicable regulations. A non-transportation project located in a nonattainment or maintenance area is subject to the General Conformity Rule (42 United States Code Section 7596 (c) (Section 176(c)) and it's implementing regulation at 40 Code of Federal Regulations (CFR) Section 93. A proposed project must undergo a general conformity analysis to ensure that the following criteria in the Clean Air Act, Section 176(c), are not violated by the project:

- cause or contribute to new violations of any standard in any area;

- increase the frequency or severity of an existing violation of any standard; or
- delay timely attainment of any standard, required interim emission reduction, or other milestones.

As part of the general conformity process, a conformity analysis is required if a federal action satisfies the following condition.

- The action's direct and indirect emissions have the potential to emit one or more of the six criteria pollutants at or above emission rates shown in Tables 8-7 and 8-8.

Therefore, if the total direct and indirect emissions associated with the proposed program are below the *de minimis* levels for criteria pollutants indicated in Tables 8-7 and 8-8, general conformity requirements do not apply, and the proposed program is considered in conformity and would not result in an significant impact. Table 8-6 summarizes the attainment status of counties in the program area for criteria pollutants. According to Table 8-6, a general conformity determination must be made for ozone, CO, and PM2.5 in Butte County; ozone, CO, and PM2.5 in Placer County; ozone, CO, PM10, and PM2.5 in Sacramento County; ozone, CO, and PM2.5 in Solano County; ozone and PM2.5 in Sutter County; ozone, CO, and PM2.5 in Yolo County; and PM2.5 in Yuba County. Colusa, Glenn, and Tehama Counties are all designated as unclassified/attainment for all criteria pollutants listed in Tables 8-7 and 8-8, so unless the attainment status changes before program implementation, no conformity determination would be required for these counties.

Table 8-7. Federal *de minimis* Threshold Levels for Criteria Pollutants in Nonattainment Areas

Pollutant	Emission Rate (Tons per Year)
Ozone (ROG/VOC or NO_X)	
Serious nonattainment areas	50
Severe nonattainment areas	25
Extreme nonattainment areas	10
Other ozone nonattainment areas outside an ozone transport region[a]	100
Other ozone nonattainment areas inside an ozone transport region[a]	
ROG/VOC	50
NO_X	100
CO: All nonattainment areas	100
SO_2 or NO_2: All nonattainment areas	100
PM10	
Moderate nonattainment areas	100
Serious nonattainment areas	70
PM2.5	
Direct emissions	100
SO_2	100
NO_X (unless determined not to be a significant precursor)	100
ROG/VOC or ammonia (if determined to be significant precursors)	100
Pb: All nonattainment areas	25

Source: 40 CFR 93.153.
Note: *de minimis* threshold levels for conformity applicability analysis.
[a] Ozone Transport Region is comprised of the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, the Consolidated Metropolitan Statistical Area that includes the District of Columbia and northern Virginia (Section 184 of the Clean Air Act).

Table 8-8. Federal *de minimis* Threshold Levels for Criteria Pollutants in Maintenance Areas

Pollutant	Emission Rate (Tons per Year)
Ozone (NO_X, SO_2 or NO_2)	
All maintenance areas	100
Ozone (ROG/VOC)	
Maintenance areas inside an ozone transport region[a]	50
Maintenance areas outside an ozone transport region[a]	100
CO: All maintenance areas	100
PM10: All maintenance areas	100
PM2.5	
Direct emissions	100
SO_2	100
NO_X (unless determined not to be a significant precursor)	100
ROG/VOC or ammonia (if determined to be significant precursors)	100
Pb: All maintenance areas	25

Source: 40 CFR 93.153.

Note: *de minimis* threshold levels for conformity applicability analysis.

[a] Ozone Transport Region is comprised of the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, the Consolidated Metropolitan Statistical Area that includes the District of Columbia and northern Virginia (Section 184 of the Clean Air Act).

CEQA

For this analysis, an impact was considered significant under CEQA if it would result in any of the following environmental impacts, which are based on professional practice and Appendix G of the State CEQA Guidelines:

The proposed program would result in a significant effect on air quality if it would:

- Conflict with or obstruct implementation of the applicable air quality plan;
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- Result in a cumulatively considerable net increase of any criteria pollutant for which the program region is nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors);
- Expose sensitive receptors to substantial pollutant concentrations; or
- Create objectionable odors affecting a substantial number of people.

The proposed program would result in a significant effect on climate change if it would:

- Generate GHG emissions that may have a significant impact on the environment.
- Conflict with an applicable plan adopted for the purpose of reducing GHG emissions.

In addition, the State CEQA Guidelines state that the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the determinations above (see Appendix C, Regulatory Background). Significant criteria for each of the various air districts are summarized in Table 8-9. Impacts related to air quality are determined using the local thresholds identified in Table 8-9 based on the appropriate air district the program activity is located within.

Table 8-9. Air Quality Districts and Counties Affected by the Proposed Program and Associated Significance Thresholds

Air District	Affected Counties	Threshold Type	ROG	NO_X	PM10	PM2.5	CO	GHGs
Bay Area Air Quality Management District (BAAQMD)[a]	Solano	Construction	54 lbs/day	54 lbs/day	82 lbs/day (exhaust) BMP (dust)[b]	54 lbs/day (exhaust) BMP (dust)[b]	N/A	N/A
		Operational	54 lbs/day	54 lbs/day	82 lbs/day (exhaust)	54 lbs/day (exhaust)	Violation of CAAQS	10,000 MT CO_2e/year (stationary sources)
Butte County Air Quality Management District (BCAQMD)	Butte	Construction	N/A[c]	N/A[c]	N/A[c]	N/A	N/A	N/A
		Operational	137 lbs/day[d]	137 lbs/day[d]	137 lbs/day[d]	N/A	N/A	N/A
Colusa County Air Pollution Control District (CCAPCD)	Colusa	Construction	25.0 lbs/day	25.0 lbs/day	80.0 lbs/day	N/A	500.0 lbs/day	N/A
		Operational	25.0 lbs/day	25.0 lbs/day	80.0 lbs/day	N/A	500.0 lbs/day	N/A
Feather River Air Quality Management District (FRAQMD)	Sutter Yuba	Construction	25 lbs/day[e]	25 lbs/day[e]	80 lbs/day	N/A	N/A	N/A
		Operational	25 lbs/day	25 lbs/day	80 lbs/day	N/A	N/A	N/A
Glenn County Air Pollution Control District (GCAPCD)	Glenn	Construction	N/A	N/A	N/A[f]	N/A[f]	N/A	N/A
		Operational	N/A	N/A	N/A	N/A	N/A	N/A
Placer County Air Pollution Control District (PCAPCD)	Placer	Construction	82 lbs/day	82 lbs/day	82 lbs/day	N/A	550 lbs/day[g]	N/A
		Operational	82 lbs/day	82 lbs/day	82 lbs/day	N/A	550 lbs/day[g]	N/A
Sacramento Metropolitan Air Quality Management District (SMAQMD)	Sacramento	Construction	N/A	85 lbs/day	Violation of CAAQS	Violation of CAAQS	Violation of CAAQS	N/A
		Operational	65 lbs/day	65 lbs/day	Violation of CAAQS	Violation of CAAQS	Violation of CAAQS	N/A
Tehama County Air Pollution Control District (TCAPCD)	Tehama	Construction	137 lbs/day[d]	137 lbs/day[d]	137 lbs/day[d]	N/A	N/A	N/A
		Operational	137 lbs/day[d]	137 lbs/day[d]	137 lbs/day[d]	N/A	N/A	N/A
Yolo-Solano Air Quality Management District (YSAQMD)	Solano Yolo	Construction	10 tons/year	10 tons/year	80 lbs/day	N/A	Violation of CAAQS	N/A
		Operational	10 tons/year	10 tons/year	80 lbs/day	N/A	Violation of CAAQS	N/A

Notes for Table 8-9

Source: Adapted from: Bay Area Air Quality Management District 2012; Butte County Air Quality Management District 2008; Chang pers. comm.; Feather River Air Quality Management District 2010; Gomez pers. comm.; Ledbetter pers. comm.; Sacramento Metropolitan Air Quality Management District 2011; Tehama County Air Pollution Control District 2009; Williams pers. comm.; Yolo-Solano Air Quality Management District 2007.

Notes: This table includes mass-emissions thresholds only. Thresholds for TACs and odors are not included.

N/A = Not Applicable; lbs/day = pounds per day; BMP = Best Management Practices; MT = metric tons.

[a] In March 2012, an Alameda County Superior Court ruled that BAAQMD needed to comply with CEQA prior to adopting their 2010 Air Quality CEQA Guidelines. As a result, the most recent guidelines are not formally adopted and are considered draft. The court ruling addressed the process of adoption of the guidelines, not the technical justification for the BAAQMD recommended thresholds. Although the most recent guidelines can only be considered draft, this document uses the recommended thresholds because the BAAQMD has provided evidence based justifications for all proposed thresholds that the City finds them to be well- grounded, based on the best available on scientific evidence and reasoning concerning air quality and greenhouse gas emissions, and therefore appropriate for use in CEQA evaluations.

[b] Construction activities would be required to implement the applicable dust control BMPs according to BAAQMD CEQA Guidelines.

[c] Operational emission thresholds apply to construction if construction will last 6 months to a year. (BCAQMD)

[d] The thresholds shown are the Level C Threshold for projects that may result in potential significant air quality impacts. (BCAQMD and TCAPCD)

[e] NO_X and ROG construction emissions may be averaged over the life time of the project, but may not exceed 4.5 tons/year. (FRAQMD)

[f] Although GCAPCD does not have specific construction and operational emission thresholds, they require water trucks onsite during construction, and they require any earth-moving activities to be suspended during wind events exceeding 15 mph.

[g] If CO thresholds are exceeded, modeling can be done to demonstrate that state and federal criteria will not be exceeded. (PCAPCD)

Effects and Mitigation Measures

Alternative 1–No Action

Under Alternative 1, construction activities associated with the proposed program would not occur. Therefore, direct and indirect construction and operational emissions would not occur as a result of the proposed program. As described above, construction-related HAP/TAC exposure is typically related to DPM exhaust emissions from construction equipment. While pre-scheduled levee maintenance would continue to be conducted under current policies, there would be no change compared with current (baseline) conditions. However, although no construction associated with the proposed program would occur, current policy is to protect eroding sites during emergencies. This policy may result in construction and operational emissions associated with emergency actions. Consequently, this alternative has the potential to result in significant effects pertaining to air quality and climate change under NEPA and CEQA.

Alternative 2A—Low Maintenance

Effect AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels

Under Alternative 2A, construction emissions would result from materials delivery, construction equipment activity, and hauling debris away from the program area. The excavation amounts, materials required, acreage disturbed, type and number of construction equipment pieces, haul routes, and duration of construction activities associated with Alternative 2A are not known at this time. Therefore, it is not possible to make a definite quantitative conformity determination. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 (linear feet) LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Construction emissions associated with Alternative 2A would have a significant effect under NEPA if they exceed the d*e minimis* levels shown in Tables 8-7 and 8-8. Depending on the jurisdiction, scale, and construction activities of an individual project, implementation of Mitigation Measure AQ-MM-1a that includes the applicable mitigation measures to reduce on-site emissions from fugitive dust and tailpipe exhaust could reduce the severity of this effect to a level that is less than significant. However, it is possible that Mitigation Measure AQ-MM-1a would not be sufficient to reduce the construction emissions of a project to quantities below the d*e minimis* thresholds. For projects with NO_X emissions exceeding the d*e minimis* thresholds after the implementation of Mitigation Measure AQ-MM-1a, the NO_X emission effect would be mitigated to a less than significant level through the implementation of Measure AQ-MM-1b, which will require the project to offset the NO_X emissions generated by construction activities to net zero (0). For projects with ROG, CO, and PM emissions exceeding the d*e minimis* thresholds after the implementation of Mitigation Measure AQ-MM-1a, there would be no other applicable measures to further reduce or offset the emissions; therefore, the effect would be significant and unavoidable under NEPA.

Mitigation Measure AQ-MM-1a: Apply Applicable Air District's Mitigation Measures to Reduce Construction Emissions below *de minimis* Threshold Levels

Appropriate construction mitigation measures from the applicable air district will be applied to reduce this effect to less than significant. Applicable mitigation measures are presented in Appendix D, Air Quality Mitigation Measures by Air District, which lists measures from the following air districts with jurisdiction in the program area: BAAQMD, BCAQMD, CCAPCD, FRAQMD, GCAPCD, PCAPCD, SMAQMD, TCAPCD, and YSAQMD. Mitigation measures vary by air district, but some examples of mitigation measures are implementation of a Fugitive Dust Control Plan, minimization of vehicle and equipment idling time, maintaining all construction equipment in proper working condition according to manufacturer's specifications, using a modern equipment fleet or installing emission control devices on older equipment to reduce exhaust emissions, and use of low-emission diesel equipment.

Mitigation Measure AQ-MM-1b: Offset Construction-Generated NO_X Emissions to Net Zero (0) for NO_X Emissions in Excess of *de minimis* Thresholds

If on-site mitigation measures identified in Mitigation Measure AQ-MM-1a are not sufficient to reduce the NO_X emissions below the de minimis thresholds, the project sponsor will coordinate with air districts with jurisdiction to offset the NO_X emissions generated by construction activities to net zero (0).

Effect AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels

Under Alternative 2A, operational emissions would result from minor amounts of routine maintenance and landscaping. Because these activities are expected to be relatively minor and would not generate elevated levels of pollutant emissions, these operational activities are not expected to exceed federal *de minimis* thresholds, but the extent of these activities is not known at this time. Therefore, no definite conformity determination can be made. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Operational emissions associated with Alternative 2A would have a significant effect under NEPA if they exceed the d*e minimis* levels shown in Tables 8-7 and 8-8. However, implementation of Mitigation Measure AQ-MM-2 would reduce the severity of this effect to a level that is less than significant.

Mitigation Measure AQ-MM-2: Apply Applicable Air District's Mitigation Measures to Reduce Operational Emissions below Federal *de minimis* Thresholds

Appropriate operational mitigation measures from the applicable air district will be applied to reduce this effect to less than significant. Applicable mitigation measures are presented in Appendix D, Air Quality Mitigation Measures by Air District, which lists measures from the following air districts with jurisdiction in the program area: BAAQMD, BCAQMD, CCAPCD, FRAQMD, GCAPCD, PCAPCD, SMAQMD, TCAPCD, and YSAQMD. Mitigation measures vary by air district, but some examples of mitigation measures are implementation of a Fugitive Dust Control Plan, minimization of vehicle and equipment idling time, maintaining all construction equipment in proper working condition according to manufacturer's specifications, using a modern equipment fleet or installing emission control devices on older equipment to reduce exhaust emissions, and use of low-emission diesel equipment.

Effect AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards

Under Alternative 2A, construction emissions would result from materials delivery, construction equipment activity, and hauling debris away from the program area. The excavation amounts, materials required, acreage disturbed, type and number of construction equipment pieces, haul routes, and duration of construction activities associated with Alternative 2A are not known at this time. Therefore, it is not possible to determine the construction-related effects based on a quantitative analysis. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Under CEQA, construction emissions associated with Alternative 2A would have a significant effect if they exceed any of the applicable air districts' threshold levels shown in Table 8-9. Implementation of Mitigation Measure AQ-MM-3 would reduce the severity of this effect. However, because the jurisdiction, scale, and construction activities of an individual project are unknown, it is possible that construction emissions may not be reduced below the air districts' threshold levels after implementing mitigation measures required by air districts. Therefore, the effect would be significant and unavoidable under CEQA.

Mitigation Measure AQ-MM-3: Apply Applicable Air District's Mitigation Measures to Reduce Construction Emissions below Applicable Air District's Thresholds

Appropriate construction mitigation measures from the applicable air district will be applied to reduce this effect to less than significant. Applicable mitigation measures are presented in Appendix D, Air Quality Mitigation Measures by Air District, which lists measures from the following air districts with jurisdiction in the program area: BAAQMD, BCAQMD, CCAPCD, FRAQMD, GCAPCD, PCAPCD, SMAQMD, TCAPCD, and YSAQMD. Mitigation measures vary by air district, but some examples of mitigation measures are implementation of a Fugitive Dust Control Plan, minimization of vehicle and equipment idling time, maintaining all construction equipment in proper working condition according to manufacturer's specifications, using a modern equipment fleet or installing emission control devices on older equipment to reduce exhaust emissions, use of low-emission diesel equipment, and acquisition of emission reduction credits.

Effect AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related HAPs/TACs

As previously mentioned, the TAC/HAP resulting from the proposed program would be DPM emissions resulting from diesel-powered construction equipment. Sensitive receptors near construction sites could be affected by DPM emissions. The extent of construction activities is not known at this time, so a determination of effects is not possible based on a quantitative analysis. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Under CEQA, this would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-4 would reduce the severity of this effect to a level that is less than significant.

Mitigation Measure AQ-MM-4: Apply Applicable Air District's Mitigation Measures to Reduce HAP/TAC Emissions below the Applicable Air District's HAP/TAC Thresholds

Appropriate HAP/TAC mitigation measures from the applicable air district will be applied to reduce this effect to less than significant. Applicable mitigation measures that will help reduce HAP/TAC emissions are presented in Appendix D, Air Quality Mitigation Measures by Air District, which lists measures from the following air districts with jurisdiction in the program area: BAAQMD, BCAQMD, CCAPCD, FRAQMD, GCAPCD, PCAPCD, SMAQMD, TCAPCD, and YSAQMD. Mitigation measures vary by air district, but some examples of mitigation measures are minimization of vehicle and equipment idling time, maintaining all construction equipment in proper working condition according to manufacturer's specifications, using a modern equipment fleet or installing emission control devices on older equipment to reduce exhaust emissions, use of low-emission diesel equipment, and acquisition of emission reduction credits.

Effect AQ-5: Generation of Operational Emissions in Excess of Applicable Standards

Under Alternative 2, operational emissions would result from routine maintenance and landscaping. These operational activities are not expected to exceed air district thresholds, but the extent of these activities is not known at this time. Therefore, effects resulting from operational activities cannot be determined based on a quantitative analysis. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Under CEQA, operational emissions associated with Alternative 2A would have a significant effect if they exceed the applicable air district's operational thresholds shown in Table 8-9. However, implementation of Mitigation Measure AQ-MM-5 would reduce the severity of this effect to a level that is less than significant.

Mitigation Measure AQ-MM-5: Apply Applicable Air District's Mitigation Measures to Reduce Operational Emissions below Applicable Air District's Thresholds

Appropriate operational mitigation measures from the applicable air district will be applied to reduce this effect to less than significant. Applicable mitigation measures are presented in Appendix D, Air Quality Mitigation Measures by Air District, which lists measures from the following air districts with jurisdiction in the program area: BAAQMD, BCAQMD, CCAPCD, FRAQMD, GCAPCD, PCAPCD, SMAQMD, TCAPCD, and YSAQMD. Mitigation measures vary by air district, but some examples of mitigation measures are implementation of a Fugitive Dust Control Plan, minimization of vehicle and equipment idling time, maintaining all construction equipment in proper working condition according to manufacturer's specifications, using a modern equipment fleet or installing emission control devices on older equipment to reduce exhaust emissions, use of low-emission diesel equipment, and acquisition of emission reduction credits.

Effect AQ-6: Generation of Construction GHG Emissions that May Have a Significant Impact on the Environment

Under Alternative 2A, construction GHG emissions would result from materials delivery, construction equipment activity, and hauling debris away from the program area. The excavation amounts, materials required, acreage disturbed, type and number of construction equipment pieces, haul routes, and duration of construction activities associated with Alternative 2A are not known at this time. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

No air quality districts in the program area have formally adopted GHG thresholds for construction-related emissions, and only BAAQMD has established GHG thresholds for operational-related emissions (i.e. stationary sources and land use developments). Because the construction activities, specific project locations, and air districts with jurisdiction are not known at this time and there are no applicable GHG thresholds for construction activities, it is not possible to determine the construction-related GHG effects based on a quantitative analysis. However, because construction GHG emissions for large earthmoving and bank protection projects are likely to be substantial and because of the cumulative nature of GHGs, construction GHG emissions associated with Alternative 2A could result in a significant contribution to regional GHG emission levels and are considered to have a significant effect on climate change under NEPA and CEQA. Implementation of Mitigation Measure AQ-MM-6 would reduce GHG emissions during construction. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Mitigation Measure AQ-MM-6: Implement Measures to Minimize GHG Emissions from Construction Activities

The following measures will be considered to lower GHG emissions from construction activities. These mitigation measures combine the currently proposed mitigation measures published by SMAQMD (2011) and BAAQMD (2012).

- Improve fuel efficiency from construction equipment.
- Perform on-site material hauling with trucks equipped with on-road engines (if determined to be less emissive than the off-road engines).
- Use electricity from utility power lines rather than fossil fuel, where appropriate.
- Encourage construction workers to carpool.
- Reduce electricity use in the construction office by using compact fluorescent bulbs, powering off computers every day, and replacing heating and cooling units with more efficient ones.
- Use alternative-fueled (e.g., biodiesel, electric) construction vehicles/equipment for at least 15% of the fleet.
- Recycle at least 75% of construction waste and demolition debris.
- Use at least 20% locally sourced or recycled materials for construction materials.

- Develop a plan to efficiently use water for adequate dust control.
- Comply with all applicable future GHG regulations at the time of project-level permitting and construction.

Effect AQ-7: Generation of Operational GHG Emissions that May Have a Significant Impact on the Environment

Under Alternative 2A, operational emissions would result from routine maintenance and landscaping. These operational activities are not expected to generate substantial GHG emissions, but the extent of these activities is not known at this time. Therefore, GHG effects resulting from operational activities cannot be determined based on a quantitative analysis. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

No air quality districts in the program area have formally adopted GHG thresholds for emissions related to operations, and only BAAQMD has established GHG thresholds for operational-related emissions (i.e. stationary sources and land use developments). Because the extent of the maintenance activities, specific project locations, and air districts with jurisdictions are not known at this time and there are no applicable GHG thresholds for operation activities, it is not possible to determine the GHG emission effects based on a quantitative analysis. However, because of the cumulative nature of GHGs, for this programmatic assessment, GHG emissions associated with Alternative 2A during operation are considered to have a significant effect on climate change. Implementation of Mitigation Measure AQ-MM-6, which is also applicable to operational maintenance activities, would reduce GHG emissions. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels

The effects of Alternative 3A would be similar to those described under Alternative 2A, because construction emissions would also result from materials delivery, construction equipment activity, and hauling debris away from the program area. Under Alternative 3A, construction emissions would result from materials delivery, construction equipment activity, and hauling debris away from the program area associated with construction of a setback levee or an adjacent levee. The excavation amounts, materials required, acreage disturbed, type and number of construction equipment pieces, haul routes, and duration of construction activities associated with Alternative 3A are not known at this time. Therefore, it is not possible to make a definite quantitative conformity determination. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Construction emissions associated with Alternative 3A would have a significant effect if they exceed the d*e minimis* levels shown in Tables 8-7 and 8-8.

Depending on the jurisdiction, scale, and construction activities of an individual project, implementation of Mitigation Measure AQ-MM-1a that includes the applicable mitigation measures to reduce on-site emissions from fugitive dust and tailpipe exhaust could reduce the severity of this effect to a level that is less than significant. However, it is possible that Mitigation Measure AQ-MM-1a would not be sufficient to reduce the construction emissions of a project to quantities below the d*e minimis* thresholds. For projects with NO_X emissions exceeding the d*e minimis* thresholds after the implementation of Mitigation Measure AQ-MM-1a, the NO_X emission effect would be mitigated to a less than significant level through the implementation of Measure AQ-MM-1b, which will require the project to offset the NO_X emissions generated by construction activities to net zero (0). For projects with ROG, CO, and PM emissions exceeding the d*e minimis* thresholds after the implementation of Mitigation Measure AQ-MM-1a, there would be no other applicable measures to further reduce or offset the emissions; therefore, the effect would be significant and unavoidable under NEPA.

Effect AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels

The effects of Alternative 3A would be similar to those described under Alternative 2A, because Alternative 3A would also result in operational emissions from routine maintenance and landscaping. Because these activities are expected to be relatively minor and would not generate elevated levels of pollutant emissions, these operational activities are not expected to exceed federal *de minimis* thresholds, but the extent of these activities is not known at this time. Therefore, no definite conformity determination can be made. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Operational emissions associated with Alternative 3A would have a significant effect under NEPA if they exceed the d*e minimis* levels shown in Tables 8-7 and 8-8. Implementation of Mitigation Measure AQ-MM-2 would reduce the severity of this effect to a level that is less than significant.

Effect AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards

The effects of Alternative 3A would be similar to those described under Alternative 2A, because Alternative 3A would also result in construction emissions from materials delivery, construction equipment activity, and hauling debris away from the program area. The excavation amounts, materials required, acreage disturbed, type and number of construction equipment pieces, haul routes, and duration of construction activities associated with Alternative 3A are not known at this time. Therefore, it is not possible to determine the construction-related effects based on a quantitative analysis. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Under CEQA, construction emissions associated with Alternative 3A would have a significant effect if they exceed any of the applicable air districts' threshold levels shown in Table 8-9. Implementation of Mitigation Measure AQ-MM-3 would reduce the severity of this effect. However, because the jurisdiction, scale, and construction activities of an individual project are unknown, it is possible that construction emissions may not be reduced below the air districts' threshold levels after implementing mitigation measures required by air districts. Therefore, the effect would be significant and unavoidable under CEQA.

Effect AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related TACs/HAPs

The effects of Alternative 3A would be similar to those described under Alternative 2A. As previously mentioned, the TAC/HAP resulting from the proposed program would be DPM emissions resulting from diesel-powered construction equipment. Sensitive receptors near construction sites could be affected by DPM emissions. The extent of construction activities is not known at this time, so a determination of effects is not possible based on a quantitative analysis. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Under CEQA, this would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-4 would reduce the severity of this effect to a level that is less than significant.

Effect AQ-5: Generation of Operational Emissions in Excess of Applicable Standards

The effects of Alternative 3A would be similar to those described under Alternative 2A, because Alternative 3A would also result in operational emissions from routine maintenance and landscaping. These operational activities are not expected to exceed air district thresholds, but the extent of these activities is not known at this time. Therefore, effects resulting from operational activities cannot be determined based on a quantitative analysis. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Under CEQA, operational emissions associated with Alternative 3A would have a significant effect if they exceed the applicable air district's operational thresholds shown in Table 8-9. Implementation of Mitigation Measure AQ-MM-5 would reduce the severity of this effect to a level that is less than significant.

Effect AQ-6: Generation of Construction GHG Emissions that May Have a Significant Impact on the Environment

The effects of Alternative 3A would be similar to those described under Alternative 2A, because Alternative 3A would also result in construction emissions from materials delivery, construction equipment activity, and hauling debris away from the program area. The excavation amounts, materials required, acreage disturbed, type and number of construction equipment pieces, haul routes, and duration of construction activities associated with Alternative 2A are not known at this time. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

No air quality districts in the program area have formally adopted GHG thresholds for construction-related emissions; and only BAAQMD has established GHG thresholds for operational-related emissions (i.e. stationary sources and land use developments). Because the construction activities, specific project locations, and air districts with jurisdictions are not known at this time and there are no applicable GHG thresholds for construction activities, it is not possible to determine the construction-related GHG effects based on a quantitative analysis. However, because construction GHG emissions for large earthmoving and bank protection projects are likely to be substantial and because of the cumulative nature of GHGs, construction GHG emissions associated with Alternative 3A could result in a significant contribution to regional GHG emission levels and are considered to have a significant effect on climate change. Implementation of Mitigation Measure AQ-MM-6 would reduce GHG emissions during construction. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Effect AQ-7: Generation of Operational GHG Emissions that May Have a Significant Impact on the Environment

The effects of Alternative 3A would be similar to those described under Alternative 2A, because Alternative 3A would also result in operational emissions from routine maintenance and landscaping. These operational activities are not expected to generate substantial GHG emissions, but the extent of these activities is not known at this time. Therefore, GHG effects resulting from operational activities cannot be determined based on a quantitative analysis. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

No air quality districts in the program area have formally adopted GHG thresholds for emissions related to operations, and only BAAQMD has established GHG thresholds for operational-related emissions (i.e. stationary sources and land use developments). Because the extent of the maintenance activities, specific project locations, and air districts with jurisdictions are not known at this time and there are no applicable GHG thresholds for construction activities, it is not possible to determine the GHG emission effects based on a quantitative analysis. However, because of the cumulative nature of GHGs, GHG emissions associated with Alternative 3A during operation are considered to have a significant effect on climate change. Implementation of Mitigation Measure AQ-MM-6, that is also applicable to operational maintenance activities, would reduce GHG emissions. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Alternative 4A—Habitat Replacement (Preferred Alternative)

The effects of Alternative 4A would be similar to those described above under Alternatives 2A and 3A, because this alternative applies a combination of site-specific bank protection measures (Bank Protection Measures 1–5) and because construction emissions would also result from materials delivery, construction equipment activity, and hauling debris away from the program area. Under this alternative, off-site mitigation is acceptable and mitigation would be provided within the region of impact (i.e., Region 1a, 1b, 2, or 3).

Effect AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels

This would be considered a potentially significant effect. Implementation of Mitigation Measures AQ-MM-1a and AQ-MM-1b would reduce the severity of this effect. However, depending on the jurisdiction, scale, and construction activities of an individual project, the mitigation measure may not be sufficient to reduce the ROG, CO, and PM emissions below the d*e minimis* thresholds. Therefore, the effect would be significant and unavoidable under NEPA.

Effect AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-2 would reduce the severity of this effect to a level that is less than significant under NEPA.

Effect AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-3 would reduce the severity of this effect. However, because the jurisdiction, scale, and construction activities of an individual project are unknown, it is possible that construction emissions may not be reduced below the air districts' threshold levels after implementing mitigation measures required by air districts. Therefore, the effect would be significant and unavoidable under CEQA.

Effect AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related HAPs/TACs

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-4 would reduce the severity of this effect to a level that is less than significant under CEQA.

Effect AQ-5: Generation of Operational Emissions in Excess of Applicable Standards

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-5 would reduce the severity of this effect to a level that is less than significant under CEQA.

Effect AQ-6: Generation of Construction GHG Emissions that May Have a Significant Impact on the Environment

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-6 would reduce the severity of this effect. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Effect AQ-7: Generation of Operational GHG Emissions that May Have a Significant Impact on the Environment

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-6, that is also applicable to operational maintenance activities, would reduce the severity of this effect. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

The effects of Alternative 5A would be similar to those described under Alternative 4A and would also apply a combination of site-specific bank protection measures (Bank Protection Measures 1–5). However, Alternative 5A differs in that it minimizes the use of off-site mitigation through the application of fewer site-specific bank protection measures that result in significant habitat effects.

Effect AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels

This would be considered a potentially significant effect. Implementation of Mitigation Measures AQ-MM-1a and AQ-MM-1b would reduce the severity of this effect. However, depending on the jurisdiction, scale, and construction activities of an individual project, the mitigation measure may not be sufficient to reduce the ROG, CO, and PM emissions below the d*e minimis* thresholds. Therefore, the effect would be significant and unavoidable under NEPA.

Effect AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-2 would reduce the severity of this effect to a level that is less than significant under NEPA.

Effect AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-3 would reduce the severity of this effect. However, because the jurisdiction, scale, and construction activities of an individual project are unknown, it is possible that construction emissions may not be reduced below the air districts' threshold levels after implementing mitigation measures required by air districts. Therefore, the effect would be significant and unavoidable under CEQA.

Effect AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related HAPs/TACs

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-4 would reduce the severity of this effect to a level that is less than significant under CEQA.

Effect AQ-5: Generation of Operational Emissions in Excess of Applicable Standards

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-5 would reduce the severity of this effect to a level that is less than significant under CEQA.

Effect AQ-6: Generation of Construction GHG Emissions that May Have a Significant Impact on the Environment

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-6 would reduce the severity of this effect. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Effect AQ-7: Generation of Operational GHG Emissions that May Have a Significant Impact on the Environment

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-6, that is also applicable to operational maintenance activities, would reduce the severity of this effect. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

The effects of Alternative 6A would be similar to those described under Alternative 4A. Alternative 6A applies the bank protection measures from the 2009 Alternatives Report without modification (Bank Protection Measures 1, 4a, 4b, 4c, and 5). A number of these bank protection measures include protection of existing vegetation and placement of on-site mitigation vegetation within the VFZ and would require an ETL variance. Off-site mitigation is acceptable and would be provided within the region of impact (e.g., Region 1a, 1b, 2, or 3).

Effect AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels

This would be considered a potentially significant effect. Implementation of Mitigation Measures AQ-MM-1a and AQ-MM-1b would reduce the severity of this effect. However, depending on the jurisdiction, scale, and construction activities of an individual project, the mitigation measure may not be sufficient to reduce the ROG, CO, and PM emissions below the d*e minimis* thresholds. Therefore, the effect would be significant and unavoidable under NEPA.

Effect AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-2 would reduce the severity of this effect to a level that is less than significant under NEPA.

Effect AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-3 would reduce the severity of this effect. However, because the jurisdiction, scale, and construction activities of an individual project are unknown, it is possible that construction emissions may not be reduced below the air districts' threshold levels after implementing mitigation measures required by air districts. Therefore, the effect would be significant and unavoidable under CEQA.

Effect AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related HAPs/TACs

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-4 would reduce the severity of this effect to a level that is less than significant under CEQA.

Effect AQ-5: Generation of Operational Emissions in Excess of Applicable Standards

This would be considered a potentially significant effect. However, implementation of Mitigation Measure AQ-MM-5 would reduce the severity of this effect to a level that is less than significant under CEQA.

Effect AQ-6: Generation of Construction GHG Emissions that May Have a Significant Impact on the Environment

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-6 would reduce the severity of this effect. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Effect AQ-7: Generation of Operational GHG Emissions that May Have a Significant Impact on the Environment

This would be considered a potentially significant effect. Implementation of Mitigation Measure AQ-MM-6, that is also applicable to operational maintenance activities, would reduce the severity of this effect. However, until the air districts develop appropriate significance thresholds for the evaluation of construction GHG emissions for the project-level analysis, the effect is considered significant and unavoidable under NEPA and CEQA.

Chapter 9
Noise and Vibration

Introduction and Summary

This section addresses noise effects associated with the proposed program. It describes the affected environment, the noise and vibration effects that would result from the proposed program, and the mitigation measures that would reduce these e key sources of data and information used in the preparation of this chapter are as follows:

- Program area county general plans.
- Program area local noise ordinances.
- Roadway Construction Noise Model User's Guide (Federal Highway Administration 2006).
- Technical Noise Supplement (California Department of Transportation 2013).
- Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish (California Department of Transportation 2009).
- Transportation and Construction-Induced Vibration Guidance Manual (California Department of Transportation 2013).
- Transit Noise and Vibration Impact Assessment (Federal Transit Administration 2006).
- Community Noise (Environmental Protection Agency 1971).

Table 9-1 summarizes the noise and vibration effects resulting from the implementation of the action alternatives.

Table 9-1. Summary of Noise and Vibration Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
Effect NOI-1: Exposure of Sensitive Receptors Adjacent to Levee Construction Sites to Temporary Construction-Related Noise	NOI-MM-1: Employ Noise-Reducing Construction Practices to Comply with Applicable Noise Criteria	Prior to and during construction
Effect NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases	None required	Not applicable
Effect NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration	NOI-MM-2: Conduct Vibration Monitoring at Buildings within 40 feet of Construction Equipment	During construction

Effect	Mitigation Measures	Implementation Period
Effect NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities	NOI-MM-1: Employ Noise-Reducing Construction Practices to Comply with Applicable Noise Criteria	Prior to and during construction
	NOI-MM-3: Employ Emergency Repair Practices to Reduce Noise Where Feasible	

Noise Terminology

A brief background discussion of noise terminology follows.

- **Sound.** A vibratory disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.
- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
- **Decibel (dB).** A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micro-pascals.
- **A-Weighted Decibel (dBA).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear. Table 9-2 shows the range of typical dBA noise levels.
- **Equivalent Sound Level (L_{eq}).** The equivalent steady state sound level that in a stated period of time would contain the same acoustical energy.
- **Maximum and minimum sound levels (L_{max} and L_{min}).** The maximum and minimum sound levels measured during a measurement period.
- **Peak Sound Level (L_{peak}).** The highest instantaneous noise level (typically lasting less than about 1/32 of a second) during the measurement period.
- **Percentile-Exceeded Sound Level (L_{xx}).** The sound level exceeded "x" percent of a specific time period. For example, L_{10} is the relatively loud sound level exceeded only 10% of the time, while the L_{90} is a relatively quiet sound exceeded 90% of the time.

Table 9-2. Typical A-Weighted Sound Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	—110—	Rock band
Jet flyover at 1,000 feet		
	—100—	
Gas lawnmower at 3 feet		
	—90—	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	—80—	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower, 100 feet	—70—	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	—60—	
		Large business office
Quiet urban daytime	—50—	Dishwasher in next room
Quiet urban nighttime	—40—	Theater, large conference room (background)
Quiet suburban nighttime		
	—30—	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	—20—	
		Broadcast/recording studio
	—10—	
	—0—	

Source: California Department of Transportation 2013.

The perceptibility of a new noise source that intrudes into a background noise environment depends on the nature of the intruding sound compared to the background sound. In general, if the intruding sound has the same character as the background sound (e.g., an increase in continuous traffic noise compared to background continuous traffic noise), human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling or halving the sound level. However, if the intruding sound is of a character different from the background sound (e.g., construction noise in an otherwise quiet neighborhood), the intruding sound can be clearly discernible even if it raises the overall dBA noise level by less than 1 dB.

All of the alternatives (including Alternative 1—No Action) would require use of conventional construction equipment to either construct levee improvements or to maintain the levees. Table 9-3 lists noise levels generated by representative types of construction equipment. For some of the alternatives all construction equipment would operate on land, but some alternatives would include waterside equipment, such as tugs and barge-mounted cranes and loaders, to transfer delivered rock and soil to the levee.

Table 9-3. Typical Construction Equipment Noise Emission Levels

Equipment	Typical Noise Level (L_{max})[1]
Air Compressor	78
Backhoe	78
Compactor	83
Crane	81
Dozer	82
Dump Truck	76
Excavator	81
Forklift[3]	75
Front-End Loader	79
Grader	85
Haul Truck[2]	76
Maintainer[5]	77
Paver	77
Pickup Truck	75
Impact Pile Driver (Will not be used for proposed program, included here only for comparison purposes)	101
Trackhoe[4]	78
Scraper	84
Tugboat	82 Continuous L_{eq} at 50 feet
Water Truck[2]	76

Source: Federal Highway Administration 2006 and Federal Transit Administration 2006.

[1] dBA, A-weighted decibel level, measured at 50 feet.

[2] Based on data for dump truck.

[3] Based on data for pickup truck.

[4] Based on data for backhoe.

[5] Based on data for paver.

Vibration Terminology

Operation of heavy construction equipment, particularly pile driving and other impulsive devices such as pavement breakers, create seismic waves that radiate along the surface of the earth and downward into the earth. These surface waves can be felt as ground vibration. Vibration from operation of this equipment can result in effects ranging from annoyance of people to damage of structures. Varying geology and distance will result in different vibration levels containing different frequencies and displacements. In all cases, vibration amplitudes will decrease with increasing distance. As seismic waves travel outward from a vibration source, they excite the particles of rock and soil through which they pass and cause them to oscillate. The actual distance the soil particles move is usually only a few ten-thousandths to a few thousandths of an inch. The rate or velocity (in inches per second) at which these particles move is the commonly accepted descriptor of the vibration amplitude, referred to as the "peak particle velocity" (PPV).

Table 9-4 summarizes typical human response to prolonged steady state vibration such as that produced by typical nonimpact construction activity during earthmoving activity.

Table 9-4. Human Response to Steady State Vibration

PPV	Human Response
3.6 (at 2 Hz)–0.4 (at 20 Hz)	Very disturbing
0.7 (at 2 Hz)–0.17 (at 20 Hz)	Disturbing
0.20	Potential damage to interior plaster walls
0.10	Strongly perceptible
0.035	Distinctly perceptible
0.012	Slightly perceptible
Source: California Department of Transportation 2004.	

Table 9-5 summarizes ground vibration levels generated by typical construction equipment.

Table 9-5. Vibration Source Levels for Construction Equipment

Equipment	PPV at 25 feet
Vibratory roller	0.210
Large bulldozer	0.089
Loaded trucks	0.076
Jackhammer	0.035
Small bulldozer	0.003
Sources: Federal Transit Administration 2006.	

Vibration amplitude attenuates over distance and is a complex function of how energy is imparted into the ground and the soil conditions through which the vibration is traveling. Historically, vibration effects caused by construction activity occur mainly in cases where both the construction site and the receptor are on bedrock, which readily transmits vibration. With regards to the proposed program, ground vibration propagates weakly through loose, alluvial soil such as that found in the program area (Federal Transit Administration 2006). Therefore, ground vibration from construction equipment is expected to be discernible only for very short distances from the construction site (roughly 40 feet away).

Environmental Setting

Existing Noise Environment

Background noise levels at the rural project sites are generally low, governed primarily by light boat traffic on the Sacramento River, heavy traffic near high-volume highways and freeways near the river, light traffic on roads atop the levee, use of tractors and aircraft on agricultural lands behind the levee, and aircraft departure and landing activity associated with the Sacramento International Airport.

Based on historical measured noise levels taken at representative rural and urban settings (U.S. Environmental Protection Agency 1971), it is assumed that existing 1-hour L_{eq} noise levels at the remote rural sites are in the range of 35–50 dBA during the day and 30–40 dBA at night. Daytime noise levels at sites located within small towns (Rio Vista, Walnut Grove, Hood, Knights Landing, Yuba City) are assumed to be 50 to 55 dBA. Daytime noise levels at sites within 100 feet of high-volume freeways or highways are assumed to be 55 to 65 dBA (California Department of Transportation 2013).

Existing ground vibration levels are presumed to be undiscernible at locations beyond the road shoulders of high-speed roads near the levees. Proposed construction activity could generate significant vibration levels, so this effect is discussed later in this analysis.

The proposed program has a negligible potential to generate ground-borne noise. In a limited number of unusual cases (e.g., a railroad tunnel constructed underneath a concert hall) ground vibration transmitted through bedrock can cause nearby structures to vibrate and generate a low frequency rumble inside the structure. However, that unusual case is not relevant to the proposed program. Therefore, this effect is not discussed further.

General Types of Noise-Sensitive Land Uses

Noise-sensitive land uses generally are defined as locations where people reside or where the presence of elevated noise emissions could significantly affect the use of the land. Noise-sensitive locations can include riverside or landside areas close to individual construction sites and staging areas, or locations close to access roads used for substantial haul truck traffic. Typical sensitive receptors include riverside or landside residents, school children, hospital patients, and the elderly, among others. Noise sensitive receptors can also include riverside parks where quiet conditions are important for normal conversation between park users, and outdoor use areas at riverside businesses (e.g., outdoor dining areas at restaurants) where quiet conditions are important for businesses and customers.

Regulatory Setting

Appendix C, Regulatory Background, describes the local noise regulations, ordinances, and policies that define allowable noise limits for program construction and operation. There are no federal noise regulations applicable to the proposed program. However, construction noise impact criteria recommended by the Federal Transit Administration is presented here for consideration when local numerical noise criteria are not applicable or available. The Federal Transit Administration suggests that the 8-hour Leq during daytime hours should be limited to 80 dBA during daytime hours and 70 dBA during nighttime hours (Federal Transit Administration 2006).

Pertinent laws, regulations, and policies are listed below.

- Federal:
  - National Environmental Policy Act
- State:
  - California Environmental Quality Act

- Local:
  - Butte County General Plan Health and Safety Element
  - Colusa County General Plan Noise Element
  - Glenn County Noise Ordinance
  - Placer County Code
  - City of Sacramento Noise Ordinance
  - Sacramento County Noise Ordinance
  - City of Rio Vista General Plan Safety and Noise Element
  - Solano County General Plan Noise Element
  - Sutter County General Plan
  - City of Yuba City Municipal Code
  - Tehama County General Plan Noise Element
  - City of West Sacramento Municipal Code
  - Yolo County General Plan Health and Safety Element
  - City of Marysville Municipal Code
  - Yuba County Noise Ordinance

Determination of Effects

Assessment Methods

Construction activities (including construction equipment used for long-term maintenance) are the predominant source of noise and vibration associated with the program. Construction noise effects have been assessed using an analysis method recommended by the U.S. Department of Transportation for construction of large public works infrastructure projects (Federal Transit Administration 2006). Based on anticipated construction equipment types and methods of operation, construction noise levels for various elements of the construction process have been calculated. These predicted levels were compared to significance criteria to determine whether significant effects are predicted to occur. Where significant noise effects have been identified, mitigation measures to reduce noise effects have been specified.

The magnitude of construction noise effects at noise-sensitive land uses depends on the type of construction activity, the noise level generated by various pieces of construction equipment, the distance between the activity and noise-sensitive land uses, and whether the ground between the source and the receiver is " acoustically hard" (e.g., pavement, reflective water) or "acoustically soft" (e.g., unpaved soil). For this analysis noise levels at various distances from the construction equipment were estimated using calculation procedures recommended by the Federal Transit Administration (2006). The calculations used for this analysis include distance attenuation (6 dB per doubling of distance) and attenuation from ground absorption for and soft ground (an additional 1.5 dB per doubling of distance).

Significance Criteria

The assessment of potential effects takes into consideration the significance of an action in terms of its context and its intensity as required under NEPA and CEQA. The environmental checklist in the State CEQA Guidelines Appendix G provides guidance to be used in determining the significance of noise effects. A noise effect is considered significant if it would:

- Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- Expose persons to or generate excessive groundborne vibration. This criterion is relevant because the program could require temporary levee construction in close proximity to existing structures;
- Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project;
- For a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, expose people residing or working in the project area to excessive noise levels. This significance criterion is only relevant for projects or programs that would attract new residents and businesses to parcels near airports. The proposed program would not do this, so this criterion is not relevant for the proposed program, and it is not discussed further;
- For a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels. Similar to the discussion above, this significance criterion is not applicable for the proposed program, so it is not discussed further;

Program-specific significance criteria were developed for this effects analysis. These criteria were developed based on the CEQA guidelines listed above and on site-specific or other applicable noise standards. The program was considered to result in a significant noise or vibration effect if one or more of the following were predicted to occur:

- Exterior or interior noise levels caused by levee improvements or levee maintenance activity exceed allowable daytime or nighttime noise levels specified in the local noise ordinance or the General Plan noise element applicable to the given location.
- If there is no numerical noise standard for a given location, or if temporary construction activity is exempted from numerical noise standards, then a significant noise effect is considered to occur if construction noise is predicted to exceed a daytime (7 a.m. to 7 p.m.) exterior noise level (1-hour L_{eq}) of 70 dBA, or an evening/nighttime (7 p.m. to 7 a.m.) exterior noise level of 60 dBA (1-hour L_{eq}). These criteria were derived by subtracting 10 dBA from the construction noise limits specified the Federal Transit Administration for construction of transit projects (Federal Transit Administration 2006). The 10 dBA adjustment was made to Federal Transit Administration's suggested criteria to account for the rural nature of the program area, where background noise levels are likely much lower than the urban areas where most Federal Transit Administration transit projects are usually constructed.
- Project-related haul truck traffic is predicted to cause traffic noise to increase of 12 dBA (peak-hour L_{eq}) or more compared to the existing peak-hour L_{eq} at any noise sensitive receptor within

500 feet of the access road. The California Department of Transportation defines a 12 dB noise increase as a "substantial" noise increase. (California Department of Transportation 2011).

- Construction equipment is predicted to cause PPV ground vibration at an occupied building to exceed 0.10 inches/second. That PPV vibration level is considered to be "strongly discernible" during prolonged construction activity using nonimpact equipment (California Department of Transportation 2013). A significant vibration effect is also considered to occur if construction activity is predicted to cause PPV vibration at structures to exceed 0.2 inches/second. This is the vibration threshold that Federal Transit Administration suggests for non-engineered timber and masonry buildings. (Federal Transit Administration 2006).

Noise effects on fish and wildlife associated with the proposed program are discussed further in Chapter 11, Fisheries and Aquatics, and Chapter 12, Wildlife.

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, construction activities associated with the proposed program would not occur. Consequently, the proposed program would not result in the exposure of sensitive receptors to temporary construction-related noise effects, including traffic noise increases and construction-related vibration. While scheduled levee maintenance and any required emergency repairs would continue to be conducted under current policies, there would be no change compared with current (baseline) conditions.

Alternative 2A—Low Maintenance

Effect NOI-1: Exposure of Sensitive Receptors Adjacent to the Levee Construction Sites to Temporary Construction-Related Noise

This alternative would involve installing revetment along the levee slope and streambank from the levee's toe to crest. Although construction under Alternative 2A could take place on the waterside or the landside, construction equipment assumed for use under this alternative includes a barge-mounted clamshell unloading rock onto the water side of the levee, and one excavator spreading the emplaced rock. Table 9-6 summarizes noise levels projected from these pieces of equipment at various distances.

Table 9-6. Noise Levels during Construction of Bank Fill Rock Slope

Distance Between Source and Receiver (ft.)	Calculated 1–Hour L_{eq} Sound Level (dBA)
50	82
100	74
200	66
300	61
400	58
500	56
1,000	48
1,500	43
2,000	40
3,000	35

Calculations based on Federal Transit Administration 2006.
Note: This calculation does not include the effects, if any, of local shielding provided by walls, topography or other barriers that may reduce sound levels further.

Noise-sensitive land uses are located throughout the program area and include residences on the waterside and landside of the existing levees. In most cases, construction activity would be short-term, intermittent, and located far from any noise-sensitive receptors. Therefore, construction-related noise effects would generally be less than significant.

However, temporary construction noises could result in significant effects on residents, recreationists, and other noise-sensitive groups, if levee construction activity was required near those receptors. For purposes of comparing noise effects for the alternatives, the forecast radial distance to the 60 dBA noise contour is used as an indicator of the relative noise effects. The 60 dBA level is the nighttime significance criterion that has been adopted for this specific noise analysis for cases where numerical local noise ordinances standards are not applicable or available (see discussion in Appendix C, *Regulatory Background*). For this alternative, intermittent noise levels generated by construction could exceed 60 dBA at distances up to 300 feet from the construction zone.

As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is be programmatic in nature, analyzing the 80,000 linear feet (LF) of the program area in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

Because it is possible that bank protection activities may occur within 300 feet of noise-sensitive land uses (i.e., residences adjacent to construction sites), this effect is considered significant. Implementation of Mitigation Measure NOI-MM-1 would reduce this effect. However, it may not be feasible in all cases to reduce noise to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Mitigation Measure NOI-MM-1: Employ Noise-Reducing Construction Practices to Comply with Applicable Noise Criteria

The Corps and its contractors will employ noise-reducing construction practices such that construction noise complies with applicable local noise ordinance requirements. Where there is no local noise ordinance, outdoor construction noise (1-hour L_{eq}) at the closest noise-sensitive receptor will be limited to 70 dBA between the hours of 7 a.m. and 10 p.m., and 60 dBA between the hours of 10 p.m. and 7 a.m. (see discussion under Significance Criteria for derivation of this criterion).

Prior to the start of construction, the Corps' contractor will prepare a noise control plan that will identify feasible measures that will be employed to reduce construction noise where necessary. The following is a list of measures that may be employed to reduce construction noise when construction activities will occur within 500 feet of a noise-sensitive receptor.

- Provide written notice to residents within 1,000 feet of the construction zone, advising them of the estimated construction schedule. This written notice will be provided within 1 week to 1 month of the start of construction at that location.
- Display notices with information including contractor contact telephone number and proposed construction dates and times in a conspicuous manner, such as on construction site fences.
- Schedule the loudest and most intrusive construction activities during daytime hours (7 a.m. to 7 p.m.) where feasible.
- Require that construction equipment be equipped with factory-installed muffling devices or better, and that all equipment be operated and maintained in good working order to minimize noise generation.
- Locate stationary noise-generating equipment as far as practical from noise-sensitive uses.
- Limit unnecessary engine idling (i.e., more than 5 minutes) as required by state air quality regulations.
- Employ equipment that is specifically designed for low noise emission levels, where feasible.
- Employ equipment that is powered by electric or natural gas engines as opposed to those powered by gasoline fuel or diesel, where feasible.
- If the construction zone is within 500 feet of a noise-sensitive receptor, place temporary barriers between stationary noise equipment and noise-sensitive receptors (where feasible based on access constraints) or take advantage of existing barrier features (terrain, structures, edge of trench) to block noise transmission.
- If the construction zone is within 500 feet of a noise-sensitive receptor, prohibit use of backup alarms and provide an alternate warning system, such as a flagman or radar-based alarm, that is compliant with state and federal worker safety regulations.
- Locate construction staging areas as far as practical from noise-sensitive receptors.
- Design truck haul routes to avoid sensitive receptors, to the extent practical.

Effect NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases

This alternative is not expected to generate high volumes of haul truck traffic along public roads. Although each passing truck might cause intermittent discernible noise, it is unlikely that haul truck traffic would cause the hourly average L_{eq} noise levels at homes near the haul route to increase enough to exceed existing peak-hour background noise by more than 12 dBA (the Caltrans criterion for a substantial noise increase). Therefore, this effect is considered to be less than significant and no mitigation is necessary.

Effect NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration

This alternative would not involve pile driving, which is the type of construction activity that can cause the most severe vibration effects. Ground vibration generated by construction equipment planned for the proposed program would be discernible only at residences within about 40 feet of the construction equipment. Table 9-7 shows estimated ground vibration levels generated by a vibratory compactor, which is the type of equipment (other than pile drivers) most likely to cause vibration effects at a construction site. As listed in Table 9-7, the vibration level is expected to dissipate to less than the impact criterion of 0.10 inches/second (the strongly discernible level) at distances more than 40 feet from the compactor. If the vibratory roller was used within 30 feet of a building, then it is possible vibration could damage interior plaster walls. Based on this analysis, it is concluded that ground vibration could cause a significant effect if construction is required within 40 feet of a vibration-sensitive building. Implementation of Mitigation Measure NOI-MM-2 would reduce this effect, but it may not be feasible in all cases to reduce vibration below the significance threshold. This effect is, therefore, significant and unavoidable.

Table 9-7. Estimated Ground Vibration Levels Caused by Vibratory Roller

Distance from Construction Equipment (feet)	Ground Vibration PPV (inches/second)
25	0.21
30	0.20—Potential damage to interior plaster walls
40	0.10—"Strongly discernible" impact criterion
50	0.07
100	0.026

Based on Federal Transit Administration 2006, and California Department of Transportation 2004. Assumes a single vibratory roller, with a source vibration level (PPV) of 0.210 inches/second at a reference distance of 25 feet.

Mitigation Measure NOI-MM-2: Conduct Vibration Monitoring at Buildings within 40 feet of Construction Equipment

Prior to the start of construction within 40 feet of any occupied building the Corps' contractor will prepare a vibration control plan with the goal of limiting ground vibration at the building to less than 0.2 inches/second at the building structure. Measures that can be implemented to limit vibration may include:

- Provide written notice to the owner and occupants of the subject buildings, advising them of the estimated construction schedule. This written notice will be provided within 1 week to 1 month of the start of construction at that location.
- Display notices with information including contractor contact telephone number and proposed construction dates and times in a conspicuous manner, such as on construction site fences,
- Prior to construction within 40 feet, inspect building structures and plaster or wallboard walls inside the building to inventory pre-existing cracks.

- Retain a qualified vibration specialist to measure vibration levels outside the building to ensure that vibration limits are not exceeded
- Following completion of construction within 40 feet, inspect the building structure and plaster or wallboard walls inside the building to inventory new cracks in plaster or paint, if any.
- If new cracks are identified, the Corps' contractor shall work with the building owner to promptly arrange for appropriate repairs.

Effect NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities

This section describes potential effects caused by routine, scheduled maintenance activity, as well as potential noise effects during emergency levee repairs.

Routine scheduled maintenance under this alternative is expected to use the same types of equipment that would be used for the initial construction (see Table 9-3). Similar to Effect NOI-1, the routine maintenance could subject sensitive receptors close to the construction zone to excessive noise. Implementation of Mitigation Measure NOI-MM-1 would reduce this effect. However, it may not be feasible in all cases to reduce noise to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

In addition, emergency repair activities might require rapid mobilization of construction equipment, which would have the potential to generate excessive noise levels at nearby sensitive receptors within about 400 feet (see the noise modeling for Alternative 4). This effect is considered significant. Options for feasible mitigation identified in Mitigation Measure NOI-MM-1 may be more limited during emergency repair activities than for scheduled routine maintenance. Consequently, implementation of Mitigation Measure NOI-MM-1 would not likely be feasible. Implementation of Mitigation Measure NOI-MM-3 would reduce this effect but not to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Mitigation Measure NOI-MM-3: Employ Emergency Repair Practices to Reduce Noise Where Feasible

The Corps and its contractors in charge of emergency preparedness will prepare a noise control plan that will identify feasible measures that will be employed to reduce construction noise where necessary and feasible given the available schedule before emergency levee repairs must begin. Emergency noise measures will apply to emergency construction activity within 400 feet of a noise-sensitive building. These measures may include those listed below.

- Require that construction equipment be equipped with factory-installed muffling devices or better, and that all equipment be operated and maintained in good working order to minimize noise generation.
- If feasible based on limited time frames, use equipment that is specifically designed for low noise emission levels.
- If feasible based on limited time frames, use equipment that is powered by electric or natural gas engines as opposed to equipment powered by gasoline fuel or diesel.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect NOI-1: Exposure of Sensitive Receptors Adjacent to the Levee Construction Sites to Temporary Construction-Related Noise

This alternative would involve construction of a second levee some distance landward of the existing levee, or the construction of a second levee immediately adjacent to the landward side of the existing levee. For this noise analysis it was assumed imported soil would be delivered to a staging area near the levee site, using either haul trucks or barges. Soil would be transferred from the staging area to the levee construction site using either scrapers or haul trucks. The soil would then be spread, watered, and compacted using on-land equipment to shape the new levee. The three loudest pieces of construction equipment assumed for the noise analysis are a scraper, a dozer, and a roller/compactor. Table 9-8 summarizes noise levels projected from these pieces of equipment at various distances.

Table 9-8. Estimated Noise Levels for Setback Levee and Adjacent Levee Construction

Distance Between Source and Receiver (ft.)	Calculated 1-Hour L_{eq} Sound Level (dBA)
50	84
100	76
200	68
300	63
400	60
500	58
1,000	50
1,500	45
2,000	42
3,000	37

Calculations based on Federal Transit Administration 2006.
Note: This calculation does not include the effects, if any, of local shielding provided by walls, topography or other barriers that may reduce sound levels further.

The direct on-site noise effects for this alternative would be similar to those described previously for Alternative 2A, although the number of pieces of construction equipment and the overall level of construction noise would be greater than Alternative 2A. For purposes of comparing noise, the modeled distance to the 60 dBA noise contour is about 400 feet from the construction zone. The direct on-site noise effect would be significant if the construction was done in the immediate vicinity of existing dwellings. Implementation of Mitigation Measure NOI-MM-1 would reduce this effect. However, it may not be feasible in all cases to reduce noise to a less-than-significant level. This effect is therefore considered to be significant and unavoidable.

Effect NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases

The indirect off-site traffic noise effects for this alternative would generally be similar to those described previously for Alternative 2A, but Alternative 3A might require a higher daily volume of soil haul trucks due to the large cross-sectional area for the new setback levees and adjacent levees. Regardless, it is unlikely the haul trucks would cause the peak-hour traffic noise to increase by more than the 12 dBA substantial increase criterion. Therefore, the traffic noise effect would be less than significant and no mitigation is necessary.

Effect NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration

The vibration effects for this alternative would be similar to those described previously for Alternative 2A. This effect would be significant. Implementation of Mitigation Measure NOI-MM-2 would reduce this effect but it may not be feasible in all cases to reduce vibration below the significance threshold. This effect is, therefore, significant and unavoidable.

Effect NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities

The direct on-site noise effects for this alternative would be similar to those described previously for Alternative 2A. The noise effect would be significant. Options for feasible mitigation identified in Mitigation Measure NOI-MM-1 may be more limited during emergency repair activities than for scheduled routine maintenance. Consequently, implementation of Mitigation Measure NOI-MM-1 would not likely be feasible. Implementation of Mitigation Measure NOI-MM-3 would reduce this effect but not to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect NOI-1: Exposure of Sensitive Receptors Adjacent to the Levee Construction Sites to Temporary Construction-Related Noise

This alternative would potentially involve the use of all five bank protection measures at erosion sites in the program area. For this noise analysis it was assumed imported construction materials would be delivered to a staging area near the levee site, using either haul trucks or barges. The three loudest pieces of construction equipment assumed for the noise analysis are a scraper, a dozer, and a roller/compactor. Table 9-9 summarizes noise levels projected from these pieces of equipment at various distances.

Table 9-9. Estimated Noise Levels for Adjacent Levee Construction

Distance Between Source and Receiver (ft.)	Calculated 1-Hour L_{eq} Sound Level (dBA)
50	84
100	76
200	68
300	63
400	60
500	58
1,000	50
1,500	45
2,000	42
3,000	37

Calculations based on Federal Transit Administration 2006.
Note: This calculation does not include the effects, if any, of local shielding provided by walls, topography or other barriers that may reduce sound levels further.

The direct on-site noise effects for this alternative would be similar to those described previously for Alternative 2A. For purposes of comparing noise, the modeled distance to the 60 dBA noise contour is about 400 feet from the construction zone. The noise effect for this effect would be significant if the construction was done in the immediate vicinity of existing dwellings. Implementation of Mitigation Measure NOI-MM-1 would reduce this effect. However, it may not be feasible in all cases to reduce noise to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Effect NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases

The indirect off-site traffic noise effects for this alternative would generally be similar to those described previously for Alternative 2A, but Alternative 4A might require a higher daily volume of soil haul trucks in areas where a setback levee or adjacent levee would be constructed due to the large cross-sectional area. Regardless, it is unlikely the haul trucks would cause the peak-hour traffic noise to increase by more than the 12 dBA substantial increase criterion. Therefore, the traffic noise effect would be less than significant and no mitigation is necessary.

Effect NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration

The vibration effects for this alternative would be similar to those described previously for Alternative 2A. This effect would be significant. Implementation of Mitigation Measure NOI-MM-2 would reduce this effect but it may not be feasible in all cases to reduce vibration below the significance threshold. This effect is therefore considered significant and unavoidable.

Effect NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities

The direct on-site noise effects for this alternative would be similar to those described previously for Alternative 2A. This noise effect would be significant. Options for feasible mitigation identified in Mitigation Measures NOI-MM-1 may be more limited during emergency repair activities than for scheduled routine maintenance. Consequently, implementation of Mitigation Measure NOI-MM-1 would not likely be feasible. Implementation of Mitigation Measure NOI-MM-3 would reduce this effect but not to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect NOI-1: Exposure of Sensitive Receptors Adjacent to the Levee Construction Sites to Temporary Construction-Related Noise

This alternative would potentially involve the use of all five bank protection measures at erosion sites in the program area. For this noise analysis it was assumed imported construction materials would be delivered to a staging area near the levee site, using either haul trucks or barges. The three loudest pieces of construction equipment assumed for the noise analysis are a scraper, a dozer, and a roller/compactor. Table 9-9, above, summarizes noise levels projected from these pieces of equipment at various distances.

The direct on-site noise effects for this alternative would be similar to those described previously for Alternative 2A. For purposes of comparing noise, the modeled distance to the 60 dBA noise contour is about 400 feet from the construction zone. The noise effect would be significant if the construction was done in the immediate vicinity of existing dwellings. Implementation of Mitigation Measure NOI-MM-1 would reduce this effect. However, it may not be feasible in all cases to reduce noise to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Effect NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases

The indirect off-site traffic noise effects for this alternative would generally be similar to those described previously for Alternative 2A, but this alternative might require a higher daily volume of soil haul trucks in areas where a setback levee or adjacent levee would be constructed due to the large cross-sectional area. Regardless, it is unlikely the haul trucks would cause the peak-hour traffic noise to increase by more than the 12 dBA substantial increase criterion. Therefore, the traffic noise effect would be less than significant and no mitigation is necessary.

Effect NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration

The vibration effects for this alternative would be similar to those described previously for Alternative 2A. This effect would be significant. Implementation of Mitigation Measure NOI-MM-2 would reduce this effect but it may not be feasible in all cases to reduce vibration below the significance threshold. This effect is therefore considered significant and unavoidable.

Effect NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities

The direct on-site noise effects for this alternative would be similar to those described previously for Alternative 2A. This noise effect would be significant. Options for feasible mitigation identified in Mitigation Measures NOI-MM-1 may be more limited during emergency repair activities than for scheduled routine maintenance. Consequently, implementation of Mitigation Measure NOI-MM-1 would not likely be feasible. Implementation of Mitigation Measure NOI-MM-3 would reduce the effect, but not to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect NOI-1: Exposure of Sensitive Receptors Adjacent to the Levee Construction Sites to Temporary Construction-Related Noise

This alternative would potentially involve the use of the setback levee, riparian and wetland bench, and bank fill stone bank protection measures at erosion sites in the program area. For this noise analysis it was assumed imported construction materials would be delivered to a staging area near the levee site, using either haul trucks or barges. The three loudest pieces of construction equipment assumed for the noise analysis are a scraper, a dozer, and a roller/compactor. Table 9-9, above, summarizes noise levels projected from these pieces of equipment at various distances.

The direct on-site noise effects for this alternative would be similar to those described previously for Alternative 2A. For purposes of comparing noise, the modeled distance to the 60 dBA noise contour is roughly 400 feet from the construction zone. This noise effect would be significant if the construction was done in the immediate vicinity of existing dwellings. Implementation of Mitigation Measure NOI-MM-1 would reduce this effect. However, it may not be feasible in all cases to reduce noise to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Effect NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases

The indirect off-site traffic noise effects for this alternative would generally be similar to those described previously for Alternative 2A, but this alternative might require a higher daily volume of soil haul trucks in areas where a setback levee would be constructed due to the large cross-sectional area. It is unlikely the haul trucks would cause the peak-hour traffic noise to increase by more than the 12 dBA substantial increase criterion. Therefore, this traffic noise effect would be less than significant and no mitigation is necessary.

Effect NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration

The vibration effects for this alternative would be similar to those described previously for Alternative 2A. This effect would be significant. Implementation of Mitigation Measure NOI-MM-2 would reduce this effect but it may not be feasible in all cases to reduce vibration below the significance threshold. This effect is therefore significant and unavoidable.

Effect NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities

The direct on-site noise effects for this alternative would be similar to those described previously for Alternative 2A. This noise effect would be significant. Options for feasible mitigation identified in Mitigation Measures NOI-MM-1 may be more limited during emergency repair activities than for scheduled routine maintenance. Consequently, implementation of Mitigation Measure NOI-MM-1 would not likely be feasible. Implementation of Mitigation Measure NOI-MM-3 would reduce this effect but not to a less-than-significant level. This effect is, therefore, considered to be significant and unavoidable.

Chapter 10
Vegetation and Wetlands

Introduction and Summary

This chapter describes the environmental setting associated with vegetation and wetlands, the determination of effects, the environmental effects on vegetation and wetlands that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- A California Natural Diversity Database (CNDDB) records search of the counties within 10 miles of the program area, which includes portions of Butte, Colusa, Contra Costa, Glenn, Placer, Sacramento, Yolo, Sutter, Solano, Yuba, and Tehama Counties (California Department of Fish and Game 2009).
- A U.S. Fish and Wildlife Service (USWFS) list of endangered, threatened, and proposed species for the counties in the program area: Butte, Colusa, Glenn, Placer, Sacramento, Yolo, Sutter, Solano, Yuba, and Tehama (U.S. Fish and Wildlife Service 2009).
- A list from the California Native Plant Society's (CNPS's) 2009 online Inventory of Rare and Endangered Plants (California Native Plant Society 2009).
- The California Department of Food and Agriculture's (CDFA's) Pest Ratings of Noxious Weed Species and Noxious Weed Seed (California Department of Food and Agriculture 2009).
- The California Invasive Plant Council's (Cal-IPC's) California Invasive Plant Inventory (California Invasive Plant Council 2006, 2007).
- Program area county general plans:
    - Butte County General Plan (Butte County 2010).
    - Colusa County General Plan (Colusa County 2011).
    - Glenn County General Plan (Glenn County 1993).
    - Placer County General Plan (Placer County 1994).
    - Sacramento County General Plan (Sacramento County 2011).
    - Solano County General Plan (Solano County 2008).
    - Sutter County General Plan (Sutter County 2011).
    - Tehama County General Plan (Tehama County 2009).
    - Yolo County General Plan (Yolo County 2009).
    - Yuba County General Plan (Yuba County 2011).
- Program area habitat conservation plans (HCPs) and Natural Community Conservation Plans (NCCPs):

- Butte Regional Conservation Plan (in preparation).
- Natomas Basin HCP (City of Sacramento et al. 2003).
- Yuba-Sutter HCP/NCCP (in preparation).
- Yolo Natural Heritage Program (in preparation).

- American River Parkway Plan (Sacramento County 2008)
- Existing SRBPP program- and project-level documents:
  - Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites: Sacramento River Bank Protection Project (U.S. Army Corps of Engineers 2009).
  - Final Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009: Sacramento River Bank Protection Project, Sacramento River and Tributaries, California (U.S. Army Corps of Engineers 2008).
  - Programmatic Biological Assessment for the Sacramento River Bank Protection Project Phase II, Final (Stillwater Sciences 2007).
  - Environmental Assessment/Initial Study for Five Critical Erosion Sites, River Miles 26.9 Left, 34.5 Right, 72.2 Right, 99.3 Right, and 123.5 Left Sacramento River Bank Protection Project, Draft (U.S. Army Corps of Engineers 2006a).
  - Environmental Assessment for levee repair of 14 Winter 2006 critical sites, Sacramento River Bank Protection Project, Final Report (U.S. Army Corps of Engineers 2006b).

Table 10-1 summarizes the vegetation and wetland effects resulting from the implementation of the proposed program.

Table 10-1. Summary of Vegetation and Wetland Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
VEG-1: Permanent Loss of Woody Riparian Vegetation Resulting from Compliance with the Vegetation ETL	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Develop revegetation plan prior to removal of existing riparian vegetation. Plantings will be monitored over a minimum period of time, as determined by the appropriate state and federal agencies.
	VEG-MM-2: Retain Qualified Botanists to Conduct Floristic Surveys for Special-Status Plants during Appropriate Identification Periods	As part of project-level environmental review
	VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants	As part of project-level environmental review

Effect	Mitigation Measures	Implementation Period
	VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel	Prior to any construction work
VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction	VEG-MM-2, VEG-MM-3, and VEG-MM-4	
	VEG-MM-5: Install Construction Barrier Fencing to Protect Sensitive Biological Resources Adjacent to the Construction Zone	Prior to any construction work
	VEG-MM-6: Retain a Biological Monitor	Prior to any construction work, and during construction.
VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	
VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction	VEG-MM-4, VEG-MM-5, and VEG-MM-6	
	VEG-MM-7: Redesign Proposed Projects to Avoid and Minimize Effects on Sensitive Biological Resources	As part of project-level environmental review.
	VEG-MM-8: Compensate for the Loss of Wetlands and Other Waters	Develop revegetation plan prior to removal of existing emergent wetland vegetation. Plantings will be monitored over a minimum period of time, as determined by the appropriate state and federal agencies.
VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction	VEG-MM-4, VEG-MM-5, VEG-MM-6, and VEG-MM-7	
	VEG-MM-9: Conduct a Tree Survey	As part of project-level environmental review
	VEG-MM-10: Compensate for the Loss of Protected Trees	Replacement trees will be planted upon completion of project construction and will be monitored for a period of 5 years following installation.
VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction	VEG-MM-11: Conduct a Survey to Document Invasive Plant Infestations	

Effect	Mitigation Measures	Implementation Period
	VEG-MM-12: Avoid and Minimize the Spread or Introduction of Invasive Plant Species	As part of project-level environmental review. During construction.
	VEG-MM-13: Conduct a Follow-Up Weed Survey and Implement Eradication Methods if New Infestations Are Present	Approximately 1 year after construction.
VEG-7: Potential Opportunity for Habitat Restoration in Enlarged Floodplain following Program Construction	None required	Not applicable

Environmental Setting

The environmental setting for the proposed program is discussed in terms of the general program area, the program study area, and the four program regions (1a, 1b, 2, and 3). The program study area and program regions are shown in Figure 2-1. The general program area consists of the watercourse reaches expected to contain SRBPP erosion protection sites as described in Chapter 2, Project Description. For the purposes of this chapter, the program study area consists of the general program area plus a 0.5-mile buffer within which direct or indirect impacts on resources may occur. The program study area is further divided into four program regions to provide smaller assessment areas and facilitate identifying the types and magnitude of effects that could occur within each program region as a result of the proposed program. The geographical extent of each program region is described in detail in Chapter 2, Project Description.

Existing Conditions

Program Study Area Land Cover Types

Information about land cover types known to occur within the program study area was obtained from four project-level assessment documents and an existing programmatic biological assessment (BA) for the SRBPP. The following eight land cover types have been documented in one or more regions within the program study area.

Riparian Forest

Riparian forests are typically associated with rivers, low gradient streams, and floodplains but also occur adjacent to ponds and canals. The vegetative composition of plant species in riparian forests is highly variable and dependent on geographic location, elevation, substrate, and groundwater elevation.

Riparian forests are characterized by an overstory of mature native and nonnative trees that form a canopy that can range from fairly open to mostly closed. The dominant overstory species are valley oak (*Quercus lobata*) or Fremont cottonwood (*Populus fremontii* ssp. *fremontii*). Other trees observed in riparian forests are box elder (*Acer negundo* var. *californicum*), Oregon ash (*Fraxinus latifolia*), white alder (*Alnus rhombifolia*), western sycamore (*Platanus racemosa*), coast live oak (*Quercus agrifolia*), Goodding's black willow (*Salix gooddingii*), red willow (*Salix laevigata*), and yellow willow (*Salix lucida* ssp. *lasiandra*). Nonnative tree species that are known to occur in riparian forests are black locust (*Robinia pseudoacacia*), English walnut (*Juglans regia*), edible fig (*Ficus carica*), and acacia (*Acacia* spp.). The shrub layer of riparian forests is also highly variable and can range from extremely sparse to well-developed. Representative species that occur in the shrub understory of riparian forests are buttonbush (*Cephalanthus occidentalis*), California blackberry (*Rubus ursinus*), Himalayan blackberry (*Rubus armeniacus*), California wild rose (*Rosa californica*), poison oak (*Toxicodendron diversilobum*), and California wild grape (*Vitis californica*). Blue elderberry (*Sambucus mexicana*), the host plant for the federally threatened valley elderberry longhorn beetle, is also commonly present in riparian areas.

The herbaceous understory of riparian forests typically contains a mixture of native and introduced species. Representative grasses and forbs observed were mugwort (*Artemisia douglasiana*), horsetail (*Equisetum* spp.), horseweed (*Conyza canadensis*), and Santa Barbara sedge (*Carex barbarae*). Common nonnative species include white sweet-clover (*Melilotus alba*), wild oats (*Avena* spp.), ripgut brome (*Bromus diandrus*), black mustard (*Brassica nigra*), Bermuda grass (*Cynodon dactylon*), yellow star-thistle (*Centaurea solstitalis*), prickly lettuce (*Lactuca serriola*), and curly dock (*Rumex crispus*).

Riparian Scrub

Riparian scrub is typically associated with the toe of levees and along the banks of rivers and streams and other drainages in the study area. This land cover type is distinguished from riparian forest by the dominance of shrubs and smaller trees (i.e., less than 20 feet tall), particularly willows, and it lacks a well-developed overstory of tall trees. Dominant species are frequently arroyo willow (*Salix lasiolepis*), Goodding's black willow, and narrowleaf willow (*Salix exigua*). Other species commonly observed in riparian scrub are California buttonbush, California wild rose, California blackberry, Himalayan blackberry, buttonbush, and blue elderberry.

Oak Woodlands

Oak woodlands generally occur on the upper portion or landside of levees in the study area outside of riparian zones. This land cover type is dominated by oaks (*Quercus* spp.) such as valley oak and interior live oak (*Q. wislizeni*). The canopy density ranges from relatively open to more closed. The shrub layer is typically sparse or absent, but the herbaceous layer is generally well developed. Representative grasses and forbs present in the herbaceous understory are wild oats, Santa Barbara sedge, horsetail, and ripgut brome.

Ruderal Herbaceous Vegetation

Ruderal herbaceous areas typically occur on the mid- to upper-slopes of levees and within levee crowns but also on the waterside of levees within gaps in the riparian forest canopy and as the herbaceous understory of riparian forest and riparian scrub. This land cover type is characterized by a dominance of nonnative grasses and forbs that opportunistically colonize areas subject to past and/or ongoing disturbance (e.g., plowing, mowing, herbicidal spraying). Representative ruderal species know to occur in the study area are ripgut brome, Bermuda grass (*Cynodon dactylon*), Johnson grass (*Sorghum halapense*), ryegrass (*Lolium multiflorum*), wild oats, broadleaf filaree (*Erodium botrys*), whitestem filaree (*E. moschatum*), wild cudweed (*Gnaphalium* spp.), bedstraw (*Galium aparine*), fennel (*Foeniculum vulgare*), yellow star-thistle, and milk thistle (*Silybum marianum*).

Emergent Marsh

Emergent marsh is restricted to a relatively narrow saturation zone along toes of levee slopes and is characterized by the presence of hydrophytic (i.e., "water-loving") herbaceous plant species that are able to tolerate fluctuating water levels and persist in continuously saturated soils. Vegetative cover of this community type is generally sparse due to bankline erosion caused by watercraft and high flow events, especially along major waterways. Representative species observed in emergent marsh in the study area are cattails (*Typha* spp.), tule (*Schoenoplectus* spp.), common rush (*Juncus effusus*), Santa Barbara sedge, Vasey's grass (*Paspalum urvillei*), smartweed (*Polygonum lapathifolium*), creeping water-primrose (*Ludwigia peploides* ssp. *montevidensis*), purple-top vervain (*Verbena bonariensis*), western goldenrod (*Euthamia occidentalis*), wild licorice (*Glycyrrhiza lepidota*), and bitter dogbane (*Apocynum androsaemifolium*).

Agricultural Lands

Agricultural lands occur at the outer boundary of the study area on the landside of levees. They include orchards, vineyards, row and field crops (e.g., sweet corn, tomatoes, alfalfa), and pasturelands. Pasturelands typically contain a variety of native and nonnative grasses and forbs such as tall fescue (*Festuca arundiaceae*), white clover (*Trifolium repens*), dallis grass (*Paspalum dilatatum*), and chicory (*Chichorium intybus*).

Barren

Barren areas within the study area include paved and dirt roads, dirt lots, revetment areas dominated by quarry stone or rock, and other areas that are essentially devoid of vegetation, usually through vegetation management practices such as burning or discing (i.e., turning and loosening soil). Barren substrates consist primarily of rock, pavement, and bare soil. Vegetation is typically absent; however, sparse weedy grasses and forbs may be present. Classes of revetment include angular rock, cobble, and concrete rubble.

Open Water

Open water within the study area consists of rivers, creeks, sloughs, canals, and other unnamed drainages and ponds. Watercourses within the program study area are listed in Table 2-1 in Chapter 2 and include the Sacramento, American, Feather, Bear, and Yuba Rivers; Putah Creek; and Natomas East Main Drain. Riparian forest, riparian shrub, and emergent marsh land cover types are generally located adjacent to open water areas at the outboard toes of land slopes, but areas designated as open water are essentially unvegetated. Instream woody material (IWM) (i.e., any piece of dead wood, 6 inches diameter at breast height (dbh) or larger that extends into the water at the mean summer water level) can occur within areas of open water and is an important component of many rivers and creeks in the program study area.

Other Land Cover Types in the Program Study Area

The program study area also has the potential to contain additional land cover types (e.g., annual grassland, vernal pools) that were not present in the study areas for the project-level assessments listed above. Subsequent project-level analyses that tier off this programmatic document may identify additional land cover types that could be present in future project study areas; however, for the purposes of this programmatic document, discussion will be limited to the eight land cover types known to occur in the program area.

Baseline Conditions

For the purposes of this programmatic document, the baseline conditions for each program region are discussed in terms of percentage cover of land cover types, distribution of riparian vegetation, and bank revetments.

A broad-scale analysis of existing vegetation within the program area was previously conducted by Stillwater Sciences (2007) and is summarized here. The methodology for this analysis is included in Appendix E, Riparian Vegetation Analysis. The analysis used seven vegetation cover type categories to describe the existing vegetation in the program area. These categories are based on a simplified classification of plant community types delineated in the program area by the Sacramento River Riparian Vegetation (SRRV) Project (Nelson et al. 2000). For this analysis, agricultural lands and ruderal vegetation have been added to the original SRRV classes. Therefore, the seven vegetation cover types used in this assessment are riparian forest, riparian scrub/shrub, riparian herbaceous, emergent marsh, bare ground, agricultural, and ruderal vegetation, and are described above. The classified area includes lands between the high water channel edge and the levee crest, and for areas lacking levees, a 100-foot buffer along the high water channel edge. Several sensitive plant community types occur within the program area. Sensitive natural plant communities are vegetation cover types that are especially diverse, regionally uncommon, or of special concern to local, state, and federal agencies. Riparian forest and riparian scrub/shrub communities qualify as sensitive natural communities, while the riparian herbaceous community generally does not (California Department of Fish and Game 2003). The only riparian community types dominated by exotic plant species identified within the program area in the SRRV database are monocultures of giant reed (*Arundo donax*). The area mapped as giant reed totals 9.4 acres, but is a small fraction of the overall area included in the riparian herbaceous vegetation cover type, and is mapped only along Region 1a.

Information on riparian vegetation is unevenly distributed among the four regions (Table 10-2). Most of the mapped natural riparian vegetation lies in the upper portion of the program area within Regions 2 and 3. Apparently, this bias occurs for two reasons: (1) most of the coverage does not include sloughs and other human-made canals that are more common in the lower regions (e.g., Yolo Bypass); and (2) the amount of land within the levees is greater per river mile where the levees are set farther back from the channel edge, a situation more common in the northern than in the southern regions. Only a small percentage of the program area in Region 1a is represented in the SRRV coverage because the Yolo Bypass, which comprises more than 88% of the area, is not included in the coverage.

Table 10-2. Distribution of Riparian Vegetation Information within the Program Regions[a]

Region	Total Area of Region (acres)	Area of Region Covered in SRRV Database (acres)	Percent of Total Region Covered in SRRV Database
1a	69,446	4,700	7
1b	4,482	3,646	81
2	55,638	50,691	91
3	14,007	14,007	100
Total	143,573	73,040	51

Source: Nelson et al. 2000.

[a] Based on geographic information system (GIS) coverage acquired from the SRRV Project

Of the total area mapped within the program area, more than 33% is classified as a natural riparian vegetation cover type (Table 10-3). Based on aerial photo interpretation of 1-meter resolution imagery from the National Agriculture Imagery Program (U.S. Department of Agriculture Farm Service Agency 2007), much of the remaining lands currently support a thin cover of ruderal herbaceous vegetation; however, other disturbed riparian types are also mapped, including agricultural land and disturbed bare ground. Approximately 66% of the natural riparian communities that have been mapped are riparian forest, while riparian herbaceous and riparian scrub/shrub compose nearly all of the remaining natural riparian vegetation area. Approximately 10% of the total mapped area, exclusively in the upper two regions, is classified as agricultural lands supporting herbaceous crops and orchards.

Region 1a

The majority of the natural riparian vegetation mapped with Region 1a is confined to a narrow strip along the Sacramento River (Stillwater Sciences 2007). The riparian vegetation contains approximately equal amounts of riparian forest and riparian scrub. The majority of the remaining mapped area of Region 1a consists of ruderal herbaceous vegetation with a small area of invasive giant reed. As reported in the programmatic BA, bank revetments comprise approximately 66% of the shoreline length and vary in composition (e.g., quarry rock, cobbles, rubble) and component size (e.g., small, medium, or large) (Stillwater Sciences 2007). However, revetments typically consist of large rock (i.e., greater than 20 inches in size) (Stillwater Sciences 2007).

Region 1b

Region 1b includes approximately equal proportions of both natural and disturbed riparian vegetation (Stillwater Sciences 2007). The majority of the natural riparian vegetation consists of riparian forest and most of the rest is riparian scrub. Ruderal herbaceous vegetation occurs between smaller areas of natural riparian vegetation. Similar to Region 1b, bank revetments in Region 1b account for approximately 66% of the shoreline length, and are variable in composition (e.g., quarry rock, cobbles, rubble) and component size (e.g., medium or large), although they generally consist of large rock (i.e., greater than 20 inches in size).

Table 10-3. Existing Extent of Vegetation Cover Types between Current Levees and Channel, or between Channel and 100-Foot Buffer

Vegetation Cover Type	Region 1a	Region 1b	Region 2	Region 3	Program Area Total
Riparian forest	434 9%	1,572 43%	10,607 21%	5,065 36%	17,677 24%
Riparian scrub/shrub	303 6%	117 3%	2,284 5%	698 5%	3,401 5%
Riparian herbaceous	74 2%	85 2%	1,702 3%	1,229 9%	3,090 4%
Emergent marsh	27 1%	12 0%	1,096 2%	21 0%	1,155 2%
Total natural riparian	838 18%	1,786 48%	15,689 31%	7,013 50%	25,323 35%
Bare ground	0 0%	0 0%	446 0.88%	0 0%	446 1%
Agricultural	0.0 0%	0.0 0%	5,486 11%	1,743 12%	7,228 10%
Ruderal vegetation	3,862 82%	1,860 51%	29,070 57%	5,251 37%	40,043 55%
Total disturbed riparian	3,862 82%	1,860 51%	35,002 69%	6,994 49%	47,717 66%
Total acres of SRRV coverage	4,700 100%	3,646 100%	50,691 100%	14,007 100%	73,040 100%

Note: Values are presented in acres and percentage of each region.

Region 2

The majority of Region 2 has been mapped, and natural riparian vegetation comprises slightly less than 31% of the mapped area. The distribution of riparian vegetation in Region 2 is confined to remnant stands and individual trees that have become established in sandy areas over bank revetment (Stillwater Sciences 2007). Of the natural riparian vegetation, most is classified as riparian forest, but areas of riparian scrub, emergent marsh, and riparian herbaceous vegetation are also present. Large areas within the levee confines are also classified as agricultural lands; many occur on or along the beds of bypasses and sloughs in the region (e.g., the Sutter Bypass). The remaining area is primarily classified as ruderal. Revetments comprise approximately 40% of the shoreline length in Region 2, and higher revetment coverage occurs along the mainstem Sacramento River compared to the lower Feather and Yuba Rivers. Bank revetments vary in composition (e.g., rock, cobbles, rubble) and component size (e.g., medium or large). However, revetments typically consist of medium cobble.

Region 3

Approximately half of Region 3 is mapped as natural riparian vegetation. The natural riparian vegetation in Region 3 is composed of approximately 72% riparian forest and 10% riparian scrub, which typically occurs in a narrow strip along meanders (Stillwater Sciences 2007). Herbaceous vegetation communities (e.g., ruderal herbaceous vegetation along banks) are also present in Region 3. Bank revetments in Region 3 comprise approximately 16% of the shoreline length, the lowest coverage of the four program regions. The bank revetments are variable in composition (e.g., quarry rock, cobbles, rubble) and component size (e.g., small, medium, or large), although the revetments generally consist of medium (i.e., 12–20 inches in size) rock or cobble.

Special-Status Plant Species

Special-status plant species are plants that are legally protected under the California Endangered Species Act (CESA), the federal Endangered Species Act (ESA), or other regulations, as well as species considered sufficiently rare by the scientific community to qualify for such listing. For the purposes of this programmatic-level document, special-status plant species fall into one or more of the categories listed below.

- Species listed or proposed for listing as threatened or endangered under the ESA (Title 50 Code of Federal Regulations [CFR], Section 17.12 [listed plants] and various notices in the Federal Register [FR] [proposed species]).
- Species that are candidates for possible future listing as threatened or endangered under the ESA (73 FR 75178, December 10, 2008).
- Species listed or proposed for listing by the State of California as threatened or endangered under CESA (Title 14 California Code of Regulations [CCR], Section 670.5).
- Species that meet the definitions of rare or endangered under the California Environmental Quality Act (CEQA) (State CEQA Guidelines Section 15380).
- Plants listed as rare under the California Native Plant Protection Act (California Fish and Game Code Section 1900 et seq.).
- Plants considered by the California Native Plant Society (CNPS) to be “rare, threatened, or endangered in California” (Lists 1B and 2, California Native Plant Society 2009).
- Plants listed by the CNPS as those about which more information is needed to determine their status, and those of limited distribution (Lists 3 and 4), which may be included as special-status species on the basis of local significance or recent biological information (California Native Plant Society 2009).

There were 92 special-status plant species identified as occurring within 10 miles of the program area (California Department of Fish and Game 2009). Table 10-4 lists the scientific name, common name, status, distribution, habitat requirements, known presence within the program study area, and associated program regions for each of these species. Of these 92 species, 32 species have been reported in the program study area (Table 10-4). Table 10-5 lists the number of special-status plants known from within 10 miles of the program area for each program region and the number of species located within the program study area at each region (California Department of Fish and Game 2009).

Table 10-4. Special-Status Plants Identified as Occurring Within 10 Miles of the Program Area

Common and Scientific Name	Legal Status[a] Federal/ State/CNPS	Geographic Distribution/Floristic Province[b]	Habitat Requirements	Blooming Period	Known within Program Study Area?	Potential Program Area Region/s for Occurrence
Henderson's bent grass *Agrostis hendersonii*	–/–/3.2	Scattered locations in Central Valley and adjacent foothills: Butte, Calaveras, Merced, Placer, Shasta, Tehama, and Tuolumne Counties; Oregon	Moist places in valley and foothill grassland, vernal pools; 70–305 meters	Apr–Jun	No	2, 3
Large-flowered fiddleneck *Amsinckia grandiflora*	E/E/1B.1	Historically known from Mt. Diablo foothills in Alameda, Contra Costa, and San Joaquin Counties; currently known from three natural occurrences	Cismontane woodland, valley and foothill grassland; 275–550 meters	Apr–May	No	1a
Slender silver moss *Anomobryum julaceum*	–/–/2.2	Scattered occurrences in California from Humboldt and Shasta south to Los Angeles Counties; Oregon and elsewhere	On damp rock and soil on outcrops, usually on roadcuts in broadleafed upland forest, lower montane coniferous forest, North Coast coniferous forest; 100–1,000 meters	N/A	No	1a
Mt. Diablo manzanita *Arctostaphylos auriculata*	–/–/1B.3	Endemic to Contra Costa County especially Mt Diablo area, San Francisco Bay area	Chaparral and cismontane woodland in canyons and on slopes on sandstone; 135–650 meters	Jan–Mar	No	1a
Contra Costa manzanita *Arctostaphylos manzanita* ssp. *laevigata*	–/–/1B.2	Eastern San Francisco Bay region, Mount Diablo, southern Inner North Coast Range, Vaca Mountains in Contra Costa County	Rocky sites in chaparral; 500–1,100 meters	Jan–Mar (uncommonly Apr)	No	1a
Ferris's milk-vetch *Astragalus tener* var. *ferrisiae*	–/–/1B.1	Historical range included the Central Valley from Butte to Alameda County but currently only occurs in Butte, Glenn, Colusa, and Yolo Counties	Seasonally wet areas in meadows and seeps, subalkaline flats in valley and foothill grassland; 2–75 meters	Apr–May	Yes–Regions 2, 3	1a, 1b, 2, 3
Alkali milk-vetch *Astragalus tener* var. *tener*	–/–/1B.2	Southern Sacramento Valley, northern San Joaquin Valley, eastern San Francisco Bay	Playas, on adobe clay in valley and foothill grassland, vernal pools on alkali soils; 1–60 meters	Mar–Jun	Yes–Regions 1a, 1b	1a, 1b, 2
Heartscale *Atriplex cordulata*	–/–/1B.2	Western Central Valley and valleys of adjacent foothills	Saline or alkaline soils in chenopod scrub, meadows and seeps, sandy areas in valley and foothill grassland; 1–375 meters	Apr–Oct	Yes–Regions 1a, 1b	1a, 1b, 2, 3
Brittlescale *Atriplex depressa*	–/–/1B.2	Western and eastern Central Valley and adjacent foothills on west side of Central Valley	Alkaline or clay soils in chenopod scrub, meadows and seeps, playas, valley and foothill grassland, vernal pools; 1–320 meters	Apr–Oct	No	1a, 1b, 2, 3
San Joaquin spearscale *Atriplex joaquiniana*	–/–/1B.2	Western edge of the Central Valley from Glenn to Tulare Counties	Alkaline soils in chenopod scrub, meadows and seeps, playas, valley and foothill grassland; 1–835 meters	Apr–Oct	Yes–Regions 1a, 1b, and 2	1a, 1b, 2, 3
Lesser saltscale *Atriplex minuscula*	–/–/1B.1	Sacramento and San Joaquin Valley, Butte County and from Merced County to Kern County	Sandy alkaline soils in chenopod scrub, playas, valley and foothill grassland; 15–200 meters	May–Oct	No	2, 3
Vernal pool smallscale *Atriplex persistens*	–/–/1B.2	Central Valley from Glenn to Tulare Counties	Alkaline vernal pools; 10–115 meters	Jun–Oct	No	1a, 3

Table 10-4 Continued

Common and Scientific Name	Legal Status[a] Federal/ State/CNPS	Geographic Distribution/Floristic Province[b]	Habitat Requirements	Blooming Period	Known within Program Study Area?	Potential Program Area Region/s for Occurrence
Subtle orache *Atriplex subtilis*	–/–/1B.2	Central Valley, especially San Joaquin Valley with occurrences in Butte, Fresno, Kings, Kern, Madera, Merced, and Tulare Counties	Alkali scalds and alkali grasslands, often near vernal pools; 40–100 meters	Jun–Aug (uncommonly Oct)	No	2
Big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis*	–/–/1B.2	Scattered occurrences in the Coast Ranges and Sierra Nevada foothills	Sometimes on serpentine soils in chaparral, cismontane woodland, valley and foothill grassland;90–1,555 meters	Mar–Jun	No	2
Big tarplant *Blepharizonia plumosa*	–/–/1B.1	San Francisco Bay area with occurrences in Alameda, Contra Costa, San Joaquin*, Stanislaus, and Solano Counties	Valley and foothill grassland; 30–505 meters	Jul–Oct	No	1a
Round-leaved filaree *California macrophylla* (formerly *Erodium macrophyllum*)	–/–/1B.1	Scattered occurrences in the Central Valley, southern North Coast Ranges, San Francisco Bay area, South Coast Ranges, Channel Islands, Transverse Ranges, and Peninsular Ranges	Clay soils in cismontane woodland, valley and foothill grassland; 15–1,200 meters	Mar–May	Yes–Region 2	1a, 2, 3
Butte County morning-glory *Calystegia atriplicifolia* ssp. *buttensis*	–/–/1B.2	Cascade Range and North Coast Range foothills: Butte, Del Norte, Mendocino (?), Shasta, and Tehama Counties	Rocky sites, sometimes roadsides, in chaparral and lower montane coniferous forest; 600–1,524 meters	May–Jul	No	2
Flagella-like atractylocarpus *Campylopodiella stenocarpa*	–/–/2.2	Known in California from Butte and Trinity Counties; elsewhere	Cismontane woodland; 100–500 meters	N/A	No	2, 3
Bristly sedge *Carex comosa*	–/–/2.1	Inner North Coast Ranges, High Cascade Range, Central Valley, northern Central Coast, San Francisco Bay, San Bernadino mountains, Modoc Plateau	Coastal prairie, marshes and swamps (lake margins), valley and foothill grassland; below 625 meters	May–Sep	Yes–Regions 1a, 1b	1a, 1b
Brown fox sedge *Carex vulpinoidea*	–/–/2.2	Scattered locations in the southeast Klamath Range, northern High Cascade Range, and northern Sacramento Valley; Arizona, Oregon	Freshwater marshes and swamps, riparian woodland; 25–1,200 meters	May–Jun	Yes–Regions 2, 3	1a, 2, 3
Pink creamsacs *Castilleja rubicundula* ssp. *rubicundula*	–/–/1B.2	Inner North Coast Ranges with occurrences in Butte, Colusa, Glenn, Lake, and Napa Counties	Serpentine soils in chaparral openings, cismontane woodland, meadows and seeps, valley and foothill grassland; 20–900 meters	Apr–Jun	Yes–Region 2	2, 3
Pappose tarplant *Centromadia parryi* ssp. *parryi*	–/–/1B.2	Southern North Coast Ranges, southern Sacramento Valley, northern and central Western California	Coastal prairie, chaparral, meadows and seeps, coastal salt marshes and swamps, vernally mesic valley and foothill grassland, often in alkaline soils; 2–420 meters	May–Nov	No	1a, 2

Table 10-4 Continued

Common and Scientific Name	Legal Status[a] Federal/ State/CNPS	Geographic Distribution/Floristic Province[b]	Habitat Requirements	Blooming Period	Known within Program Study Area?	Potential Program Area Region/s for Occurrence
Hoover's spurge *Chamaesyce hooveri*	T/–/1B.2	Central Valley from Butte to Tehama Counties	Below high water marks of large northern hardpan and volcanic vernal pools; 25–250 meters	Jul–Sep (uncommonly Oct)	Yes–Region 3	2, 3
Stony Creek spurge *Chamaesyce ocellata* ssp. *rattanii*	–/–/1B.2	Northern Sacramento Valley in Colusa, Glenn, and Tehama Counties	Chaparral, sandy or rocky areas in valley and foothill grassland; 85–800 meters	May–Oct	No	3
Brandegee's clarkia *Clarkia biloba* ssp. *brandegeeae*	–/–/1B.2	Northern Sierra Nevada foothills from Butte to El Dorado Counties	Chaparral, cismontane woodland, lower montane coniferous forest, often on roadcuts; 73–915 meters	May–Jul	Yes–Region 2	1b, 2
White-stemmed clarkia *Clarkia gracilis* ssp. *albicaulis*	–/–/1B.2	Southern Cascade Range foothills with occurrences in Butte and Tehama Counties	Chaparral and cismontane woodland, sometimes on serpentine soils; 245–1,085 meters	May–Jul	No	2, 3
Mosquin's clarkia *Clarkia mosquinii*	–/–/1B.1	Northern Sierra Nevada foothills in vicinity of Feather River Canyon near Pulga in northeast Butte County	Rocky, roadside areas in cismontane woodland and lower montane coniferous forest; 185–1,219 meters	May–Jul	No	2
Hispid bird's-beak *Cordylanthus mollis* ssp. *hispidus*	–/–/1B.1	Central and southern Central Valley with occurrences in Alameda, Fresno, Kern, Merced, Placer, and Solano Counties	Alkaline soils in meadows and seeps, playas, valley and foothill grassland; 1–155 meters	Jun–Sep	No	1a
Soft bird's-beak *Cordylanthus mollis* ssp. *mollis*	E/R/1B.2	Northern Central Coast with occurrences in Contra Costa, Marin*, Napa, Sacramento*, Solano, and Sonoma* Counties	Coastal salt marshes and swamps; below 3 meters	Jul–Nov	No	1a
Palmate-bracted bird's-beak *Cordylanthus palmatus*	E/E/1B.1	Livermore Valley and scattered locations in the Central Valley from Colusa to Fresno Counties	Alkaline grassland, alkali meadow, chenopod scrub; 5–155 meters	May–Oct	Yes–all 4 Regions	1a, 1b, 2, 3
Hoover's cryptantha *Cryptantha hooveri*	–/–/1A	Known historically from Alameda, Contra Costa, Madera, Merced, San Joaquin, and Stanislaus Counties	Inland dunes, sandy soils in valley and foothill grassland; 9–150 meters	Apr–May	No	1a
Recurved larkspur *Delphinium recurvatum*	–/–/1B.2	Central Valley from Colusa* to Kern Counties	Alkaline soils in valley and foothill grassland, saltbush scrub, cismontane woodland; 3–750 meters	Mar–Jun	No	2, 3
Norris' beard moss *Didymodon norrisii*	–/–/2.2	Scattered occurrences in Contra Costa, Colusa, Humboldt, Lake, Madera, Monterey, Nevada, Plumas, San Benito, Santa Cruz, Sierra, Tehama, Tulare, and Tuolumne Counties; Oregon	Intermittently wet areas in rock outcrops in cismontane woodland, lower montane coniferous forest; 600–1,973 meters	N/A	No	2, 3
Dwarf downingia *Downingia pusilla*	–/–/2.2	Inner North Coast Ranges, southern Sacramento Valley, northern and central San Joaquin Valley	Mesic areas in valley and foothill grassland, vernal pools; 1–445 meters	Mar–May	No	1a, 1b, 2, 3

Table 10-4 Continued

Common and Scientific Name	Legal Status[a] Federal/ State/CNPS	Geographic Distribution/Floristic Province[b]	Habitat Requirements	Blooming Period	Known within Program Study Area?	Potential Program Area Region/s for Occurrence
Mt. Diablo buckwheat *Eriogonum truncatum*	–/–/1B.1	Historically known from northeastern San Francisco Bay in Alameda and Contra Costa Counties. Presumed extinct until recent rediscovery on Mt. Diablo. Also historically known from deltaic Sacramento Valley.	Sandy soils in chaparral, coastal scrub, valley and foothill grassland; 3–350 meters	Apr–Sep (uncommonly Nov–Dec)	No	1a
Contra Costa wallflower *Erysimum capitatum* var. *angustatum*	E/E/1B.1	Known only from Contra Costa County	Inland dunes; 3–20 meters	Mar–Jul	No	1a
Diamond-petaled California poppy *Eschscholzia rhombipetala*	–/–/1B.1	Inner North and South Coast Ranges, eastern San Francisco Bay, eastern Outer South Coast Ranges	Alkaline or clay soils in valley and foothill grassland; below 975 meters	Mar–Apr	No	1a
Minute pocket moss *Fissidens pauperculus*	–/–/1B.2	Known from Butte, Del Norte, Humboldt, Mendocino, Marin, and Santa Cruz Counties	Damp, coastal soil in North Coast coniferous forest; 10–1,024 meters	N/A	No	2
Stinkbells *Fritillaria agrestis*	–/–/4.2	Outer North Coast Ranges, Sierra Nevada foothills, Central Valley, Central Western California	Clay, sometimes serpentine soils in chaparral, cismontane woodland, pinyon-juniper woodland, valley and foothill grassland; 10–1,555 meters	Mar–Jun	No	1a, 1b
Butte County fritillary *Fritillaria eastwoodiae*	–/–/3.2	Sierra Nevada foothills from Shasta to Yuba Counties	Chaparral, cismontane woodland, and openings in lower montane coniferous forest, sometimes on serpentine; 50–1,500 meters	Mar–Jun	Yes– Regions 2, 3	2, 3
Fragrant fritillary *Fritillaria liliacea*	–/–/1B.2	Central Western California with occurrences in Alameda, Contra Costa, Monterey, Marin, San Benito, Santa Clara, San Francisco, San Mateo, Solano, and Sonoma Counties	Coastal prairie, coastal scrub, valley and foothill grassland, cismontane woodland, often on serpentine; 3–410 meters	Feb–Apr	No	1a
Adobe-lily *Fritillaria pluriflora*	–/–/1B.2	Northern Sierra Nevada foothills, Inner North Coast Ranges, edges of Sacramento Valley	Often adobe soils in chaparral, cismontane woodland, valley and foothill grassland; 60–705 meters	Feb–Apr	Yes– Regions 2, 3	1a, 2, 3
Boggs Lake hedge hyssop *Gratiola heterosepala*	–/E/1B.2	Inner North Coast Ranges, central Sierra Nevada foothills, Sacramento Valley, Modoc Plateau	Clay soils in marshes and swamps along lake margins and vernal pools; 10–2,375 meters	Apr–Aug	No	1a, 1b, 2, 3
Diablo helianthella *Helianthella castanea*	–/–/1B.2	San Francisco Bay area in Alameda, Contra Costa, Marin*, San Francisco*, and San Mateo Counties	Broadleafed upland forest, chaparral, cismontane woodland, coastal scrub, riparian woodland, valley and foothill grassland; 60–1,300 meters	Mar–Jun	No	1a

Table 10-4 Continued

Common and Scientific Name	Legal Status[a] Federal/ State/CNPS	Geographic Distribution/Floristic Province[b]	Habitat Requirements	Blooming Period	Known within Program Study Area?	Potential Program Area Region/s for Occurrence
Brewer's western flax *Hesperolinon breweri*	–/–/1B.2	Southern North Inner Coast Range, northeast San Francisco Bay region, especially Mt. Diablo: Contra Costa, Napa, and Solano Counties	Chaparral, cismontane woodland, valley and foothill grassland usually on soils derived from serpentinite; 30–900 meters	May–Jul	No	1a
Rose-mallow *Hibiscus lasiocarpus*	–/–/2.2	Central and southern Sacramento Valley, deltaic Central Valley, and elsewhere in the U.S.	Freshwater marshes and swamps; below 120 meters	Jun–Sep	Yes–all 4 Regions	1a, 1b, 2, 3
California satintail *Imperata brevifolia*	–/–/2.1	San Joaquin Valley, South Coast, San Gabriel Mountains, San Bernadino Mountains, Mojave Desert; Texas, Mexico	Mesic areas in chaparral, coastal scrub, Mojavean desert scrub, meadows and seeps (often alkaline), riparian scrub; below 500 meters	Sep–May	No	2, 3
Carquinez goldenbush *Isocoma arguta*	–/–/1B.1	Deltaic Sacramento Valley in the Suisun Slough	Alkaline valley and foothill grassland; 1–20 meters	Aug–Dec	Yes–Region 1a	1a
Northern California black walnut *Juglans hindsii*	–/–/1B.1	Last two native stands in Napa and Contra Costa Counties; historically widespread through southern Inner North Coast Ranges, southern Sacramento Valley, northern San Joaquin Valley, San Francisco Bay	Riparian scrub and riparian woodland; below 440 meters	Apr–May	Yes–Regions 1a, 1b	1a, 1b
Ahart's dwarf rush *Juncus leiospermus* var. *ahartii*	–/–/1B.2	Eastern Sacramento Valley, northeastern San Joaquin Valley with occurrences in Butte, Calaveras, Placer, Sacramento, and Yuba Counties	Mesic areas in valley and foothill grassland, vernal pool margins; 30–229 meters	Mar–May	Yes–Region 2	1b, 2, 3
Red Bluff dwarf rush *Juncus leiospermus* var. *leiospermus*	–/–/1B.1	Northern Sacramento Valley and Cascade Range foothills with occurrences in Butte, Shasta, and Tehama Counties	Seasonally wet areas in chaparral, cismontane woodland, meadows and seeps, valley and foothill grassland, vernal pools; 35–1,020 meters	Mar–May	No	2, 3
Contra Costa goldfields *Lasthenia conjugens*	E/–/1B.1	North Coast, southern Sacramento Valley, San Francisco Bay, South Coast	Mesic areas in cismontane woodland, alkaline playas, valley and foothill grassland, vernal pools; below 470 meters	Mar–Jun	No	1a
Coulter's goldfields *Lasthenia glabrata* ssp. *coulteri*	–/–/1B.1	Scattered locations in southern California from San Luis Obispo County to San Diego County, in the outer South Coast Ranges, south coast, northern Channel Islands, Peninsular Rangess, western Mojave desert	Coastal salt marshes and swamps, vernal pools, playas; 1–1,220 meters	Feb–Jun	No	2, 3
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	–/–/1B.2	Central Valley, San Francisco Bay	Freshwater and brackish marshes and swamps; below 4 meters	May–Jul (uncommonly Sep)	Yes–Regions 1a, 1b	1a, 1b
Colusa layia *Layia septentrionalis*	–/–/1B.2	Inner North Coast Range: Colusa, Glenn, Lake, Mendocino, Napa, Sonoma, Sutter, Tehama, and Yolo Counties	Sandy or serpentine soils in valley and foothill grassland, chaparral, and cismontane woodland; 100–1,095 meters	Apr–May	Yes–Region 2	1a, 2, 3

Table 10-4 Continued

Common and Scientific Name	Legal Status[a] Federal/ State/CNPS	Geographic Distribution/Floristic Province[b]	Habitat Requirements	Blooming Period	Known within Program Study Area?	Potential Program Area Region/s for Occurrence
Legenere *Legenere limosa*	–/–/1B.1	Sacramento Valley, North Coast Ranges, northern San Joaquin Valley and Santa Cruz mountains	Vernal pools; 1–880 meters	Apr–Jun	No	1a, 1b, 2, 3
Heckard's pepper-grass *Lepidium latipes* var. *heckardii*	–/–/1B.2	Southern Sacramento Valley	Alkaline flats in valley and foothill grassland; 2–200 meters	Mar–May	Yes–Regions 1a, 1b	1a, 1b, 2, 3
Mason's lilaeopsis *Lilaeopsis masonii*	–/R/1B.1	Southern Sacramento Valley, northeastern San Francisco Bay	Riparian scrub, brackish or freshwater marshes and swamps; below 10 meters	Apr–Nov	Yes–Regions 1a, 1b	1a, 1b
Butte County meadowfoam *Limnanthes floccosa* ssp. *californica*	E/E/1B.1	Endemic to Butte County	Mesic areas in valley and foothill grassland, vernal pools and swales; 46–930 meters	Mar–May	No	2, 3
Woolly meadowfoam *Limnanthes floccosa* ssp. *floccosa*	–/–/4.2	Northern Sacramento Valley and Cascade Range foothills, from Siskiyou County to Butte County; Oregon	Seasonally wet areas in chaparral, cismontane woodland, valley and foothill grassland, vernal pools; 60–1,095 meters	Mar–May (uncommonly Jun)	No	2, 3
Delta mudwort *Limosella subulata*	–/–/2.1	Deltaic Central Valley with occurrences in Contra Costa, Sacramento, San Joaquin, and Solano Counties; Oregon	Marshes and swamps; below 3 meters	May–Aug	Yes–Regions 1a, 1b	1a, 1b
Showy madia *Madia radiata*		Scattered populations in the interior foothills of the South Coast Ranges: Contra Costa*, Fresno, Kings*, Kern, Monterey*, Santa Barbara*, San Benito, San Joaquin*, San Luis Obispo, and Stanislaus Counties	Cismontane woodland, valley and foothill grassland, slopes; 25–900 meters	Mar–May	No	1a
Veiny monardella *Monardella douglasii* ssp. *venosa*	–/–/1B.1	Occurrences in the northern and central Sierra Nevada foothills; also historically known from the Sacramento Valley	Heavy clay soils in cismontane woodland, valley and foothill grassland; 60–410 meters	May–Jul	Yes–Regions 1a, 1b, and 2	1a, 1b, 2, 3
Baker's navarretia *Navarretia leucocephala* ssp. *bakeri*	–/–/1B.1	Inner North Coast Ranges, western Sacramento Valley	Mesic areas in cismontane woodland, lower montane coniferous forest, meadows and seeps, valley and foothill grassland, vernal pools; 5–1,740 meters	Apr–Jul	Yes–Region 2	1a, 1b, 2, 3
Pincushion navarretia *Navarretia myersii* ssp. *myersii*	–/–/1B.1	Central Sierra Nevada foothills, central Great Valley	Vernal pools, often acidic; 20–330 meters	May	No	1b, 2
Colusa grass *Neostapfia colusana*	T/E/1B.1	Central Valley with scattered occurrences from Colusa to Merced Counties	Adobe soils of vernal pools; 5–200 meters	May–Aug	No	1a, 1b, 2, 3
Antioch Dunes evening primrose *Oenothera deltoides* ssp. *howellii*	E/E/1B.1	Known from three native occurrences in northeastern San Francisco Bay	Inland dunes; below 30 meters	Mar–Sep	Yes–Region 1a	1a

Table 10-4 Continued

Common and Scientific Name	Legal Status[a] Federal/ State/CNPS	Geographic Distribution/Floristic Province[b]	Habitat Requirements	Blooming Period	Known within Program Study Area?	Potential Program Area Region/s for Occurrence
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	T/E/1B.1	Scattered locations along east edge of the San Joaquin Valley and adjacent foothills, from Stanislaus County to Tulare County	Vernal pools; 10–755 meters	Apr–Sep	No	1a
Hairy Orcutt grass *Orcuttia pilosa*	E/E/1B.1	Scattered locations along east edge of Central Valley and adjacent foothills from Tehama to Merced Counties	Vernal pools; 46–200 meters	May–Sep	No	2, 3
Slender Orcutt grass *Orcuttia tenuis*	T/E/1B.1	Inner North Coast Ranges, Cascade Range foothills, Sacramento County	Vernal pools; 35–1,760 meters	May–Sep; uncommonly Oct	No	1b, 2, 3
Sacramento Orcutt grass *Orcuttia viscida*	E/E/1B.2	Known only from Sacramento County	Vernal pools; 30–100 meters	Apr–Jul	No	1b
Lewis Rose's ragwort *Packera eurycephala* var. *lewisrosei*	–/–/1B.2	Northern High Sierra Nevada, including the Feather River Drainage, eastern Butte and Plumas Counties	Serpentine soils in chaparral, cismontane woodland, and lower montane coniferous forest; 285–1,890 meters	Mar–Jul (uncommonly Sep)	No	2
Ahart's paronychia *Paronychia ahartii*	–/–/1B.1	Northern Central Valley in Butte, Shasta, and Tehama Counties	Cismontane woodland, valley and foothill grassland, vernal pools; 30–510 meters	Mar–Jun	No	2, 3
Bearded popcorn-flower *Plagiobothrys hystriculus*	–/–/1B.1	Presumed extinct until recent rediscovery in the Montezuma Hills	Often vernal swales in mesic valley and foothill grassland, vernal pool margins; below 274 meters	Apr–May	No	1a
Slender-leaved pondweed *Potamogeton filiformis*	–/–/2.2	Scattered locations in California: Contra Costa, El Dorado, Lassen, Merced, Mono, Modoc, Mariposa, Placer, Santa Clara*, and Sierra Counties; Arizona, Nevada, Oregon, Washington	Freshwater marsh, shallow emergent wetlands and freshwater lakes, drainage channels; 300–2,150 meters	May–Jul	No	2, 3
Eel-grass pondweed *Potamogeton zosteriformis*	–/–/2.2	Southern Inner North Coast Ranges, Central Valley, Modoc Plateau; Idaho, Oregon, Utah, Washington	Assorted freshwater marshes and swamps; below 1,860 meters	Jun–Jul	No	1a
Hartweg's golden sunburst *Pseudobahia bahiifolia*	E/E/1B.1	Central Sierra Nevada foothills, eastern San Joaquin Valley	Clay soils in cismontane woodland, valley and foothill grassland; 15–150 meters	Mar–Apr	Yes–Regions 1a, 2	1a, 2
California beaked-rush *Rhynchospora californica*	–/–/1B.1	Scattered occurrences in Northwestern California, northern and central Sierra Nevada Foothills, and northern San Francisco Bay	Bogs and fens, meadows and seeps, lower montane coniferous forest, freshwater marshes and swamps; 45–1,010 meters	May–Jul	No	2, 3
Brownish beaked-rush *Rhynchospora capitellata*	–/–/2.2	Scattered occurrences in Northwestern California and northern Sierra Nevada Foothills	Wet areas in lower and upper montane coniferous forest, meadows and seeps, marshes and swamps; 455–2,000 meters	Jul–Aug	No	2
Sanford's arrowhead *Sagittaria sanfordii*	–/–/1B.2	Scattered locations in Central Valley and Coast Ranges from Del North to Fresno Counties	Freshwater marshes, sloughs, canals, and other slow-moving water habitats; below 2,132 feet	May–Oct	Yes–Regions 1a, 1b	1a, 1b, 2, 3

Table 10-4 Continued

Common and Scientific Name	Legal Status[a] Federal/ State/CNPS	Geographic Distribution/Floristic Province[b]	Habitat Requirements	Blooming Period	Known within Program Study Area?	Potential Program Area Region/s for Occurrence
Marsh skullcap *Scutellaria galericulata*	–/–/2.2	Northern High Sierra Nevada, Modoc Plateau; Oregon	Lower montane coniferous forest, mesic meadows and seeps, marshes and swamps; below 2,100 meters	Jun–Sep	No	1a, 1b
Side-flowering skullcap *Scutellaria lateriflora*	–/–/2.2	Northern San Joaquin Valley, east of Sierra Nevada; New Mexico, Oregon	Mesic meadows and seeps, marshes and swamps; below 500 meters	Jul–Sep	Yes–Regions 1a, 1b	1a, 1b
Chaparral ragwort *Senecio aphanactis*	–/–/2.2	Scattered locations in central western and southwestern California, from Alameda County to San Diego County	Cismontane woodland, coastal scrub, chaparral, sometimes on alkaline soils; 15–800 meters	Jan–Apr	No	1a
Butte County checkerbloom *Sidalcea robusta*	–/–/1B.2	Endemic to Butte County	Chaparral, cismontane woodland; 90–1,600 meters	Apr–Jun	Yes–Regions 2, 3	2, 3
San Francisco campion *Silene verecunda* ssp. *verecunda*	–/–/1B.2	Northern Central Coast, San Francisco Bay area: San Francisco, San Mateo, Santa Cruz, and Sutter Counties	Sandy soils in coastal bluff scrub, chaparral, coastal prairie, coastal scrub, valley and foothill grassland; 30–645 meters	Mar–Aug	No	1a, 2, 3
Suisun Marsh aster *Symphyotrichum lentum* (formerly *Aster lentus*)	–/–/1B.2	Sacramento Valley, Central Coast, San Francisco Bay	Brackish and freshwater marshes and swamps; below 3 meters	May–Nov	Yes–Regions 1a, 1b	1a, 1b
Wright's trichocoronis *Trichocoronis wrightii* var. *wrightii*	–/–/2.1	Scattered locations in the Central Valley and Southern Coast; Texas	On alkaline soils in floodplains, meadows and seeps, marshes and swamps, riparian forest, vernal pools; 5–435 meters	May–Sep	Yes–Regions 1a, 2	1a, 2
Showy rancheria clover *Trifolium amoenum*	E/–/1B.1	Coast Range foothills in the San Francisco Bay region, currently known from only two recent occurrences in Marin County	Valley and foothill grassland, coastal bluff scrub, sometimes on serpentinite soils; 5–415 meters	Apr–Jun	No	1a
Butte County golden clover *Trifolium jokerstii*	–/–/1B.2	Endemic to Butte County	Mesic areas in valley and foothill grassland, vernal pools; 50–385 meters	Mar–May	No	2
Greene's tuctoria *Tuctoria greenei*	E/R/1B.1	Scattered distribution along eastern Central Valley and foothills from Shasta to Tulare Counties	Dry vernal pools; 30–1,070 meters	May–Jul (uncommonly Sep)	No	2, 3
Crampton's tuctoria *Tuctoria mucronata*	E/E/1B.1	Southwestern Sacramento Valley, Solano and Yolo Counties	Mesic areas in valley and foothill grassland, vernal pools; 5–10 meters	Apr–Aug	No	1a, 1b
Brazilian watermeal *Wolffia brasiliensis*	–/–/2.3	Few occurrences along Sacramento River in Butte and Glenn Counties; elsewhere	Assorted shallow freshwater marshes and swamps; 30–100 meters	Apr–Dec	Yes–Regions 2, 3	2, 3

Table 10-4 Continued

[a] Status explanations:

Federal

E	=	listed as endangered under the federal Endangered Species Act.
T	=	listed as threatened under the federal Endangered Species Act.
–	=	no listing.

State

E	=	listed as endangered under the California Endangered Species Act.
R	=	listed as rare under the California Native Plant Protection Act (this category is no longer used for newly listed plants, but some plants previously listed as rare retain this designation.
–	=	no listing.

California Native Plant Society (CNPS)

1A	=	List 1A species: presumed extinct in California and elsewhere.
1B	=	List 1B species: rare, threatened, or endangered in California and elsewhere.
2	=	List 2 species: rare, threatened, or endangered in California but more common elsewhere.
3	=	List 3 species: more information is needed about this plant
4	=	List 4 species: limited distribution and on a watch list.
0.1	=	seriously endangered in California.
0.2	=	fairly endangered in California.
0.3	=	not very endangered in California.
*	=	presumed extirpated from that County.
?	=	occurrence within County needs to be confirmed

[b] Floristic provinces as defined in Hickman 1993

Table 10-5. Number of Special-Status Plant Species by Region

Program Region	Special-Status Plants within 10 Miles of the Program Area	Special-Status Plants within the Program Study Area
1a	57	19
1b	30	15
2	56	18
3	44	9

Of the 92 special-status plant species identified within 10 miles of the program area, 17 are federally listed. According to the programmatic BA, the federally listed plant species are associated with habitats that are either absent from the program area levees (i.e., vernal pools, dunes) or very unlikely to occur along or adjacent to the levees (e.g., salt marsh, cismontane woodland, valley and foothill grassland) (ICF International 2012). Therefore, potential impacts on federally listed plants were not evaluated in the programmatic BA due to the lack of potential habitat. However, for the installation of a setback levee, construction, staging, and access would likely extend outside the aforementioned areas and could encroach on land cover types (e.g., annual grassland, vernal pools) that represent potential habitat for special-status plants.

Sensitive Natural Communities

Sensitive natural communities are designated as such because of their high level of species diversity, high productivity, unusual nature, limited distribution, or declining status. Local, state, and federal agencies consider these habitats important. The CNDDB maintains a current list of rare natural communities throughout the state, and seven of these communities have been reported in the program study area (California Department of Fish and Game 2009): coastal and valley freshwater marsh, elderberry savanna, Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, Great Valley valley oak riparian forest, Great Valley willow scrub, and northern hardpan vernal pool. The coastal and valley freshwater marsh, three types of riparian forest, and Great Valley willow scrub fit within the categories of the land cover types (i.e., riparian forest, emergent marsh, riparian scrub) identified in one or more of the existing project-level assessment documents that cover 57 of the levee repair sites included in the proposed program. Although elderberry savanna and northern hardpan vernal pool were not observed in the study areas of the 57 levee repair sites, they may be present in the study area and would be identified in subsequent project-level analyses that tier off this programmatic document.

Additionally, the U.S. Fish and Wildlife Service (USFWS) considers certain habitats (such as wetlands) important to wildlife, and the U.S. Army Corps of Engineers (Corps) and U.S. Environmental Protection Agency (EPA) consider wetland habitats important for water quality and wildlife. The state protects wetlands and other waters under the Porter-Cologne Water Quality Control Act (see Appendix C, Regulatory Background).

In contrast to sensitive natural communities, common natural communities have little diversity of species, and are habitats that are widespread, able to reestablish naturally after disturbance, or capable of supporting primarily nonnative species. These communities are not generally protected by agencies unless the specific site is habitat for special-status species or capable of supporting such species (e.g., raptor foraging or nesting habitat or upland habitat in a wetland watershed). The ruderal herbaceous land cover type in the program study area is considered a common natural community. The agricultural lands and barren areas are not natural communities.

Invasive Plant Species

Plant species that are considered invasive by the CDFA and Cal-IPC have been documented in the program study area (California Invasive Plant Council 2006, 2007; California Department of Food and Agriculture 2009). Giant reed, ripgut brome, black locust, yellow star-thistle, Himalayan blackberry, prickly lettuce, edible fig, fennel, and milk thistle are examples of invasive plant species that are known to occur in the program study area.

Native Tree Resources

Native trees such as Fremont cottonwood, valley oak, interior live oak, Goodding's black willow, arroyo willow, white alder, western Sycamore, box elder, and Oregon ash are known to occur in the program study area.

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, and local environmental laws, regulations, and policies that apply to vegetation and wetlands in the program area. The pertinent laws, regulations, and policies are listed below.

- Federal:
  - National Environmental Policy Act
  - Endangered Species Act
  - Clean Water Act
  - Rivers and Harbors Appropriation Act of 1899
  - Executive Order 11990: Protection of Wetlands
  - Executive Order 13112: Invasive Species
- State:
  - California Environmental Quality Act
  - California Endangered Species Act
  - California Native Plant Protection Act
  - California Fish and Game Code
  - Porter-Cologne Water Quality Control Act
- Local:
- Butte County General Plan
- Butte Regional Conservation Plan

- Colusa County General Plan
- Glenn County General Plan
- Placer County General Plan
- Placer County Tree Preservation Ordinance
- American River Parkway Plan
- Natomas Basin Habitat Conservation Plan
- Sacramento County General Plan
- Sacramento County Tree Preservation Ordinance
- Solano County General Plan
- Sutter County General Plan
- Yuba-Sutter Habitat Conservation Plan/Natural Communities Conservation Plan
- Tehama County General Plan
- Yolo County General Plan
- Yolo County Oak Woodland Conservation and Enhancement Plan
- Yolo Natural Heritage Program
- Yuba County General Plan

Determination of Effects

This section describes the effects analysis relating to vegetation and wetlands for the program study area. It describes the methods used to determine the effects of the proposed program and lists the thresholds used to conclude whether an effect would be significant. How this effect differs among reaches is discussed, if applicable. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant effects accompany each effect discussion.

Assessment Methods

The effects on vegetation and wetlands were identified based on the review of information sources listed in the Introduction and Summary section of this chapter. This effects analysis for vegetation and wetlands is qualitative and programmatic and is intended as a reference for subsequent project-level analyses within the program area. Project-level analyses will be conducted to identify, assess, and quantify the effects of future individual levee repair projects within the program area based on site-specific information. Effects on vegetation and wetlands that could result from the implementation of the proposed program are listed below, and measures to mitigate significant effects (where feasible) accompany each effect discussion.

A site-specific analysis was conducted to determine approximate amounts of riparian woodland and scrub/shrub vegetation that would be removed as a result of implementing an additional 80,000 LF of bank protection under SRBPP Phase II. A description of the analysis follows with additional detail included in Appendix E, Riparian Vegetation Analysis. The analysis utilized 2008 Digital Globe aerial imagery (1-foot resolution) in addition to levee centerline and upstream/downstream site limit data for the 106 sites.

Vegetation was mapped if it was considered to be riparian woodland or riparian scrub/shrub. Distinctions were made between these two types of vegetation to the extent practicable, and mapped as distinct GIS shape files by digitizing polygons representing areas with tree canopy (either woodland or scrub/shrub).

The extent of vegetation mapped included the area within the upstream and downstream site limits and from the levee centerline waterward to the low flow channel and landward approximately 100 feet. Vegetation within these site "boundaries" was designated and calculated as "existing vegetation."

Lines representing the approximate locations of the levee toes at each site were digitized based on aerial photo interpretation. A 15-foot buffer was applied to the outward edge of each levee toe. The area between the outermost edges of the waterside and landside 15-foot buffers is considered to be the vegetation-free zone under Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, ETL 1110-2-583 (Vegetation ETL), as applicable to each bank protection measure.

For purposes of assessing effects of the alternatives, vegetation was assumed to be removed (referred to as "removed vegetation") if it was within the footprint of features to be constructed (e.g., placement of rock or soil). Vegetation within the entire vegetation-free zone (VFZ) of each site was mapped but only the vegetation within the VFZ and project footprint is included in the removed vegetation calculation, as the proposed program is assumed to apply Vegetation ETL standards only within the construction footprint. The local maintaining agencies (LMAs) are responsible for operation and maintenance (O&M) and applying the Vegetation ETL standards to the levees; however, the Corps would apply the Vegetation ETL standards to the levee repair and within the project footprint during construction. When the site is turned over to the LMA after levee repair construction, the LMA would assume responsibility for O&M and applying ETL standards to the repair site footprint.

It is important to note that during project implementation at any individual site, all native trees within the construction footprint, but outside of the VFZ, that are greater than 4 inches dbh shall be retained to the greatest extent practicable. Tree removal shall be limited to situations where access, required equipment maneuverability, worker and public safety, and levee integrity are not reasonably possible without removal of trees. However, for purposes of this programmatic analysis a conservative approach was taken to assess the amount of riparian vegetation that will be impacted. As a result, actual tree removal during implementation is likely to be less than that quantified in this analysis.

More specifically, vegetation to be removed was calculated based on the features of each measure's design. Bank protection measure assumptions were applied as explained below.

- Bank Protection Measure 1: Setback Levee. Vegetation removal encompasses the areas where the new levee transitions into the existing levee at the upstream and downstream ends of the site.

- Bank Protection Measure 2: Rock Slope with No On-Site Woody Vegetation.: All vegetation on the waterward levee slope and extending to the low-flow river channel is removed.
- Bank Protection Measure 3: Adjacent Levee. All vegetation landward of the levee centerline and extending 50 feet is removed.
- Bank Protection Measures 4a, 4b, 4c: Riparian Benches with Revegetation. Same assumptions as under Bank Protection Measure 2.
- Bank Protection Measure 5: Bank Fill Stone Protection with On-Site Vegetation. Same as Bank Protection Measure 2 except that 25% of existing vegetation is retained.

Alternative 6, which relies on a variance from the Vegetation ETL, utilizes the following assumptions.

- Bank Protection Measures 1, 2 and 3 are the same as described above.
- Bank Protection Measures 4a, 4b, 4c, and 5 remove vegetation only in the area from the low-flow channel up to 15 feet from the waterside of the levee toe. Vegetation on the waterside levee slope and within 15 feet of the waterside levee toe is not removed.

Additionally, Bank Protection Measure 5 under Alternative 6 assumes that 25% of vegetation within the vegetation removal area is retained. Retained vegetation was calculated by subtracting removed vegetation from existing vegetation.

"Plantable area created" was calculated for each bank protection measure based on the amount of surface area that is suitable for planting riparian vegetation and outside of the VFZ. For example, bank protection measures with riparian benches were assumed to provide a planting surface that is 15 feet wide and the length of the entire site. Setback levees were assumed to provide a planting area 100 feet wide and the length of the entire site except for those areas at the upstream and downstream portions of the site where the new levee transitions into the existing levee. Rock slope with vegetation was assumed to create a plantable area equal to an area 15 feet wide for the length of the site. No plantable area created was assumed for rock slope without vegetation. While it is recognized that adjacent levees may provide opportunities for planting riparian vegetation on the waterside because the VFZ would shift landward with the footprint of the new adjacent levee, the plantable area depends on site-specific detail. Consequently, the assumption is that adjacent levees create no plantable areas.

Significance Criteria

For this analysis, an effect pertaining to vegetation and wetlands was considered significant if it would result in any of the following environmental effects, which are based on State CEQA Guidelines Appendix G (14 CCR 15000 et seq.).

- Have a substantial adverse effect, either directly or through habitat modification, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by the California Department of Fish and Wildlife (DFW) or USFWS.
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by the DFW or USFWS.

- Have a substantial adverse effect on jurisdictional wetlands as defined by Clean Water Act (CWA) Section 404 (including, but not limited to, marshes and vernal pools) through direct removal, filling, hydrological interruption, or other means.
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.
- Conflict with the provisions of an adopted HCP, NCCP, or other approved local, regional, or state habitat conservation plan.

Activities associated with the proposed program may occur in the planning area of a number of HCPs or NCCPs, though at this time, the Butte Regional Conservation Plan, Yuba Sutter HCP/NCCP, and Yolo Natural Heritage Program are still under development. The intent of the proposed program is to protect the species covered by such plans through related compliance processes (e.g., Section 7 of the ESA, the Fish and Wildlife Coordination Act, NEPA and CEQA mitigation measures). Regardless, completed HCPs and NCCPs will be consulted on a site-specific basis during project-level environmental review to ensure consistency. HCPs and NCCPs are not addressed further in this chapter.

Effect Assumptions

The following assumptions regarding program effects on vegetation and wetlands in the program study area have been made for this analysis.

- All proposed program construction activities, including equipment staging and access, would take place only within the program area.
- Project-level analyses would be conducted to assess the effects of future individual levee repair projects within the program area.
- The proposed program would comply with the Corps' maintenance policy on vegetation and levees (i.e., no vegetation is permitted within the levee's operation and maintenance zone, which includes the levee itself and an area extending 15 feet from the landside and waterside levee toes and 8 feet from toe drains or wells), unless specifically noted (e.g., Alternative 6). These areas would be maintained free of woody vegetation in perpetuity.
- Construction, staging, and project access associated with the installation of a setback levee would likely extend outside the area accompanied by existing levees, established roadways, and previously disturbed areas and could encroach on land cover types (e.g., annual grassland, vernal pools) that represent potential habitat for special-status plants.
- Fill or borrow material would be obtained from a quarry or other authorized location.
- There would be effects related to the routine operation or maintenance activities under the proposed program as required by the project's existing or future maintenance manual. The program proponent would continue with the current levee maintenance actions.
- Discharge of fill into waters of the United States associated with the proposed program would require a CWA Section 401 certification from the Central Valley Regional Water Quality Control Board. Before construction begins, the program proponent would obtain all necessary permits pertaining to affected waters of the United States. The permitting process would also require compensation for construction-, operation-, and maintenance-related effects.

- Grading would require a CWA Section 402 permit and preparation of a storm water pollution prevention plan.

Effect Mechanisms

Vegetation and wetland resources could be directly and indirectly affected by the proposed program. The following types of activities could cause varying degrees of effects on these resources.

- Grading and fill placement during construction of levee improvements.
- Channel dewatering or installation of temporary water-diversion structures.
- Temporary stockpiling and sidecasting of soil, construction materials, or other construction wastes.
- Soil compaction, dust, and water runoff from the construction site into adjacent areas.
- Introduction or spread of invasive plant species into adjacent open space areas.
- Runoff of herbicides, fertilizers, diesel fuel, gasoline, oil, raw concrete, or other toxic materials used for levee improvements, operations, and maintenance into sensitive biological resource areas (e.g., riparian habitat, wetlands).
- Introduction of substrate that has a limited capacity to support vegetation.

Effects and Mitigation Measures

Alternative 1—No Action

As described in Chapter 2, under the No Action Alternative regular O&M of the levee system would continue as presently executed by the local maintaining entities in accordance with the existing governing project O&M manual. Any effects due to routine O&M would not differ from current (baseline) conditions. The Corps would not implement bank protection along SRFCP levees under Alternative 1. The result would likely be the continued gradual or sporadic loss of remnant floodplain (berm) and the riparian vegetation it supports, and ultimately, the erosion could encroach into the cross-section of the levee foundation, creating critical erosion sites. It is possible that federal, state, or local flood control agencies would eventually implement bank protection at various sites along SRFCP levees through emergency action. In any case, the risk of levee failure and possibly catastrophic flooding would increase substantially as more erosion sites become critical and repair is limited to emergency response. Continued erosion prior to federal or state action would result in short- and long-term losses of valuable habitat. Although some erosion is natural, the channelization of project reaches increases erosive forces.

Alternative 2A—Low Maintenance

Effect VEG-1: Permanent Loss of Woody Riparian Vegetation Resulting from Compliance with the Vegetation ETL

All bank protection proposed under Alternative 2A would follow the Vegetation ETL, which forbids all woody vegetation on the crown, slopes, and within 15 feet of the waterside and landside levee toes. The Vegetation ETL would be applied to the footprints of the erosion sites, with those footprints defined by the area needed to access and construct the bank protection. These zones would be maintained free of woody vegetation in perpetuity. Thus, the removal of a substantial amount of mature trees and vegetation from the banks of the study area waterways may be required. The woody riparian community in the study area (i.e., riparian forest) is considered a sensitive natural community.

Permanent loss of the woody vegetation as a result of compliance with the Vegetation ETL could result in a substantial adverse effect on riparian habitat. The full extent of this effect would be dependent on what portion of the existing levee the Corps deems as the levee prism. In some cases, the morphology of an existing levee may exceed the minimum requirements (or may result in exceedance with the implementation of program improvements such as construction of an adjacent levee) and existing vegetation may fall outside of the VFZ. Moreover, dependent upon site conditions, variances may be issued on a case-by-case basis that would allow vegetation to remain.

Because the loss of riparian habitat as a result of the proposed program would be substantial, the disturbance and removal of riparian habitat would be considered a significant effect. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4 would reduce this effect to a lesser level. However, due to the likely need to mitigate off site and the length of time required for newly planted trees to reach mature size, this impact would remain significant.

Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat

For direct effects on woody riparian habitat that cannot be avoided, the program proponent will compensate for the loss of riparian habitat (including temporal loss) to ensure no net loss of habitat functions and values. Compensation ratios will be based on site-specific information and determined through coordination with the appropriate state and federal agencies during the permitting process. Compensation will be provided based on the ratio determined (e.g., 2:1 = 2 acres restored/created or credits purchased for every 1 acre removed). Compensation may be a combination of on-site and off-site restoration or mitigation credits. The program proponent will develop a restoration and monitoring plan that describes how riparian habitat will be recreated and monitored over a minimum period of time as determined by the appropriate state and federal agencies.

The program proponent will identify appropriate mitigation areas that are outside the vegetation-free zone and will prepare a revegetation plan. The revegetation plan will be developed prior to the removal of existing riparian vegetation and will be implemented on site or in the project vicinity and within the same region of impact (e.g., 1a, 1b, 2, or 3) to the extent feasible; however, mitigation site selection will avoid areas where future flood control maintenance is likely. The revegetation plan will be prepared by a qualified restoration ecologist or landscape architect, and reviewed by the appropriate agencies. The revegetation plan will specify the planting stock appropriate for each riparian land cover type and each mitigation site, ensuring the use of genetic stock from the program area and may include targeted special-status species. The plan will employ the most successful techniques available at the time of planting. Success criteria will be established as part of the plan and will include the following performance standards for herbaceous and woody vegetation (also listed in Table 10-6):

- Native herbaceous cover no less than 75 percent within zones predominantly planted with native herbaceous species should be attained in Year 1. In Years 2 and 3, native herbaceous cover should be no less than 50 percent. It is expected that native herbaceous cover will decline as shrub and tree cover matures; however, native herbaceous cover no less than 25 percent should be attained at program sites at the end of Year 5.
- Nonnative herbaceous cover should be minimal and account for no more than 10 percent of total herbaceous cover after Year 1, and no more than 20 percent of total herbaceous cover during Years 3 through 5.
- Program sites should have at least 10 percent cover of native tree and shrub plantings at the end of Year 1; 25 percent at the end of Year 2; 50 percent in Years 3 and 4; and 75 percent at the end of Year 5. Planted woody species should also be healthy and vigorous. At least 80 percent of the planted woody species should have a vigor of “4” in all monitoring years.

Table 10-6. Performance Standards for Herbaceous and Woody Vegetation

Monitoring Variable[a]	Year 1	Year 2	Year 3	Year 4	Year 5
Native Herbaceous Vegetation Cover	75%	50%	50%	25%	20%
Nonnative Herbaceous Vegetation Cover	10%	20%	20%	20%	20%
Woody Species Overhead Canopy Cover	10%	25%	50%	50%	75%
Woody Species Vigor	80%	80%	80%	75%	70%

[a] Based on 2012 Vegetation and Habitat Monitoring Methodology Protocol for Sacramento River Bank Protection Project Sites

If the revegetation plan includes success criteria that are different than the aforementioned criteria, then it would be analyzed in site-specific documentation. The program proponent will provide vegetation establishment and monitoring services as necessary for 3 years and additional years when success criteria have not been met within the first 3 years until success criteria are fully achieved. The program proponent will submit annual monitoring reports of survival to the regulatory agencies issuing permits related to habitat effects, including DFW, USFWS, and the National Marine Fisheries Service. Replanting will be necessary if success criteria are not met, and replacement plants will subsequently be monitored and maintained to meet the success criteria. The riparian habitat mitigation will be considered successful when the sapling trees established meet the success criteria, the habitat no longer requires active management, and vegetation is arranged in groups that, when mature, replicate the area, natural structure, and species composition of similar riparian habitats in the region.

Mitigation Measure VEG-MM-2: Retain Qualified Botanists to Conduct Floristic Surveys for Special-Status Plants during Appropriate Identification Periods

The program proponent will retain qualified botanists to survey the potentially affected areas of the study area to document the presence of special-status plants before program implementation. This will allow the program proponent to implement Mitigation Measure VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants. The botanists will conduct a floristic survey that follows the DFW botanical survey guidelines (California Department of Fish and Game 2000). All plant species observed will be identified to the level necessary to determine whether they qualify as special-status plants or are plant species with unusual or significant range extensions. The guidelines also require that field surveys be conducted when special-status plants that could occur in the area are evident and identifiable, generally during the blooming period. To account for different special-status plant identification periods, one or more series of field surveys may be required in spring and summer.

Special-status plant populations identified during the field surveys will be mapped and documented as part of the public record.

Mitigation Measure VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants

If one or more special-status plants are identified in the program study area during preconstruction surveys, the program proponent will redesign or modify proposed project components, if necessary, to avoid indirect or direct effects on special-status plants to the extent feasible.

If special-status plants can be avoided by redesigning proposed projects consistent with this mitigation measure, it shall be implemented in combination with Mitigation Measures VEG-MM-4, VEG-MM-5, and VEG-MM-6 to ensure avoidance of significant effects on special-status plants. Avoidance, minimization, and compensation measures for riparian habitat, wetlands, and protected trees are discussed separately under their respective effects (Effects VEG-3, VEG-4, and VEG-5).

If direct impacts cannot be avoided, the plants (including their root balls or rhizomes) will be transplanted to an appropriate location under the supervision of a qualified biologist or landscape architect. The qualified biologist or landscape architect will coordinate with the DFW regarding transplantation techniques and locations prior to implementation of transplantation efforts.

If transplantation of plants is required, a monitoring program (with performance requirements) will be implemented to evaluate the success of the transplantation effort. The monitoring program will be developed by a qualified biologist in coordination with DFW and will be implemented for a minimum of 3 years. If transplantation efforts are determined to be unsuccessful during the monitoring period, remedial actions will be identified and implemented in coordination with DFW. Remedial actions may include, but are not limited to, providing replacement plantings with, and continued monitoring of, plants obtained from a local native plant nursery, participating in the improvement of habitat conditions at off-site locations known to support the species, and implementing or providing financial support to conservation efforts in the watershed that would benefit regionally occurring special-status plants.

Mitigation Measure VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel

This mitigation measure relates to sensitive biological resources in general, which include vegetation as well as wildlife.

Before any work occurs in the study area, including grading, a qualified biologist will conduct mandatory contractor/worker awareness training for construction personnel. The awareness training will be provided to all construction personnel to brief them on the need to avoid effects on sensitive biological resources (e.g., riparian habitat, special-status species, special-status wildlife habitat) and the penalties for not complying with permit requirements. The biologist will inform all construction personnel about the life history of special-status species with potential for occurrence on site, the importance of maintaining habitat, and the terms and conditions of the biological opinion or other authorizing document. Proof of this instruction will be submitted to USFWS, DFW, or other overseeing agency, as appropriate. If new construction personnel are added to the program, the contractor will ensure that the personnel receive the mandatory training before starting work.

The training will also cover the restrictions and guidelines that must be followed by all construction personnel to reduce or avoid effects on special-status species during project construction. The crew foreman will be responsible for ensuring that crew members adhere to the guidelines and restrictions. Educational training will be conducted for new personnel as they are brought on the job during the construction period. General restrictions and guidelines for vegetation and wildlife that must be followed by construction personnel are listed below.

- Project-related vehicles will observe the posted speed limit on hard-surfaced roads and a 10-mile-per-hour speed limit on unpaved roads during travel in the project site.
- Project-related vehicles and construction equipment will restrict off-road travel to the designated construction area.
- All food-related trash will be disposed of in closed containers and removed from the study area at least once a week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the project site.
- No pets or firearms will be allowed in the project site.
- To prevent possible resource damage from hazardous materials such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.

For special-status wildlife, any worker who inadvertently injures or kills a special-status wildlife species (discussed in Chapter 12, Wildlife) or finds one dead, injured, or entrapped will immediately report the incident to the biological monitor. The monitor will immediately notify the program proponent, who will provide oral notification to the USFWS Endangered Species Office or the local DFW warden or biologist within 3 working days. The program proponent will follow up with written notification to USFWS or DFW within 5 working days.

Effect VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction

Construction activities associated with the proposed program would result in ground disturbance that would remove one or more habitats that could potentially contain special-status plant populations. Program construction activities could result in the direct loss or indirect disturbance of special-status plants that are known to grow or that could occur in the program area (see Table 10-4 for a list of these species). Effects on special-status plants could result in a substantial reduction in local population size, lowered reproductive success, or habitat fragmentation. If the special-status plants would not be avoided during construction activities, this alternative treatment could result in a significant impact on special-status plants. Depending on the plant (listed versus unlisted) and the extent of impact on the population, implementation of Mitigation Measures VEG-MM-2 and, if applicable, Mitigation Measures VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6 may avoid or reduce this effect to a less-than-significant level. Substantial losses of a listed plant could result in a significant effect. Because the final significance determination will need to be made on a site-specific basis during project-level implementation of the proposed program after field surveys have been conducted (Mitigation Measure VEG-MM-2) and through consultation with the appropriate resource agency (the USFWS and/or DFW), this effect is considered significant and unavoidable.

Mitigation Measure VEG-MM-5: Install Construction Barrier Fencing to Protect Sensitive Biological Resources Adjacent to the Construction Zone

The construction specifications will require that the program proponent retain a qualified biologist or landscape architect to identify sensitive biological resources (e.g., special-status species, riparian habitat, wetlands, elderberry shrubs) adjacent to the construction zone that are to be avoided during construction. Sensitive biological resources located adjacent to the directly affected area required for construction, including staging and access, will be fenced off to avoid disturbance in these areas.

Before project construction, the contractor will work with the program engineer and a resource specialist to identify the locations for the barrier fencing and will place stakes around the sensitive biological resources to indicate their locations. The protected area will be clearly identified on the construction specifications. The fencing will be installed at a minimum of 25 feet from the drip-line of each sensitive biological resource area and will be in place before construction activities are initiated. The fencing will be maintained by the program proponent or its contractor throughout the duration of the construction period. If the fencing is removed, damaged, or otherwise compromised during the construction period, construction activities will cease until the fencing is replaced by the program proponent or its contractor.

Mitigation Measure VEG-MM-6: Retain a Biological Monitor

Before any work occurs in the project construction area, including grading, the program proponent will retain qualified biologists to monitor construction activities adjacent to sensitive biological resources (e.g., special-status species, riparian habitat, wetlands, elderberry shrubs). The biologists will assist the construction crew, as needed, to comply with all project implementation restrictions and guidelines. In addition, the biologists will be responsible for ensuring that the program proponent or its contractors maintain the construction barrier fencing adjacent to sensitive biological resources.

Effect VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction

Under Alternative 2, riparian habitat that occurs outside of the VFZ but within each site's project footprint would be removed based on the analysis assumptions previously described. While the actual quantity of vegetation loss outside of the VFZ but within the project footprint may be less than assumed as a result of avoidance measures applied on a site-by-site basis during implementation, Table 10-7 summarizes the amount of riparian vegetation that would be lost as a result of Effects VEG-1 and VEG-3.

Table 10-7. Summary of Site-Specific Vegetation Analysis for Alternative 2A (acres)

	Existing Vegetation		Removed Vegetation		Retained Vegetation		Plantable Area Created
Region	Woodland	Scrub	Woodland	Scrub	Woodland	Scrub	
Region 1a	11.48	6.01	6.78	4.79	4.69	1.22	0.00
Region 1b	10.26	2.11	7.63	2.11	2.63	0.00	0.00
Region 2	9.04	0.68	4.73	0.68	4.31	0.00	0.00
Region 3	4.94	0.00	3.95	0.00	0.99	0.00	0.00
Subtotal	35.72	8.80	23.09	7.58	12.63	1.22	
Total	44.52		30.67		13.85		0.00

As previously identified in Effect FCGEOM-1, there could be indirect effects to areas upstream and downstream of an erosion site including indirect effects on vegetation. However, implementation of Mitigation Measure FCGEOM-MM-1 would ensure that indirect effects, including those on vegetation, would be avoided or be negligible.

Because the direct loss of riparian habitat as a result of the proposed program could be substantial and permanent, the disturbance and removal of riparian habitat would be considered a significant effect on riparian habitat.

Implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4 would reduce this effect to a lesser level. However, given the likely need to mitigate off site because Alternative 2 would create no plantable area and because of the length of time required for newly planted trees to reach mature size, this effect would remain significant after mitigation.

Effect VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction

The study area contains numerous features that are or have the potential to be waters of the United States, including wetlands. These features consist of those listed in Table 2-1. Construction activities associated with this alternative would result in the loss of waters of the United States, including wetlands. This effect would be considered significant because the proposed program would have a substantial adverse effect on wetlands and other waters that are protected under federal law through direct removal, filling, hydrological interruption, or other means. Implementation of

Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8 would reduce this effect to a level that is less than significant.

Mitigation Measure VEG-MM-7: Redesign Proposed Projects to Avoid and Minimize Effects on Sensitive Biological Resources

The program proponent will redesign proposed projects to avoid and minimize effects on sensitive biological resources (e.g., riparian areas outside the VFZs, wetlands, protected trees) to the extent feasible.

Mitigation Measure VEG-MM-8: Compensate for the Loss of Wetlands and Other Waters

Compensation for the loss of wetlands will include restoring or enhancing in-kind wetland habitat at a minimum ratio of 1:1; however, the final ratio will be determined through the project-specific permitting process and through coordination with resource agencies to ensure no net loss of wetland habitat functions and values. Before the removal of existing emergent wetland vegetation (i.e., emergent marsh), the program proponent will prepare a revegetation plan to compensate for the loss of wetland habitat and submit the plan to the appropriate regulatory agencies for review. The revegetation plan will be prepared by a qualified restoration ecologist or landscape architect. The revegetation plan will specify the planting stock appropriate for each wetland type and each mitigation site, ensuring the use of genetic stock from the program area and may include targeted special-status species. The plan will employ the most successful techniques available at the time of planting. Success criteria will be established as part of the plan. The revegetation will be conducted on site or in the vicinity to the extent feasible, but mitigation site selection will avoid areas where future levee improvements or maintenance would be likely. If off-site mitigation is necessary, a location that does not currently support wetlands but is capable of supporting wetland habitats should be selected. An area that currently supports minimal habitat value would be desirable. The program proponent will implement the revegetation plan, maintain plantings for a minimum of 3 years (including weed removal within the construction footprint, irrigation, and herbivory protection), and conduct annual monitoring for 3 years, followed by monitoring every 2 years for the next 6 years. Existing native wetland vegetation from the affected sites should be harvested and maintained for replanting after construction.

Effect VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction

The study area contains numerous trees that may qualify for protection under a local tree ordinance. Construction activities associated with this alternative could potentially result in the loss of protected trees, which could conflict with a local ordinance. Implementation of Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-9, and if necessary, VEG-MM-10 would reduce this effect to a level that is less than significant.

Mitigation Measure VEG-MM-9: Conduct a Tree Survey

For program study areas located in areas where a local ordinance is in place to protect trees, the program proponent will retain a certified arborist, biologist, or landscape architect to conduct a tree survey to identify protected trees in the study area. This will allow the program proponent to implement Mitigation Measure VEG-MM-10: Compensate for the Loss of Protected Trees. The arborist/biologist/landscape architect will document the results of the tree survey in a report that includes the location, species, size (dbh), overall health, and dripline diameter of the trees. If the arborist's survey does not identify any protected trees that would be removed or damaged as a result of the proposed program, no additional mitigation would be necessary. If protected trees are present, the program proponent will implement Mitigation Measure VEG-MM-10.

Mitigation Measure VEG-MM-10: Compensate for the Loss of Protected Trees

The program proponent will apply for the applicable tree permit(s) for the removal of any protected trees during construction and will comply with all permit conditions. The program proponent will retain a qualified professional (i.e., landscape architect, certified arborist, urban forester) to develop a replacement tree planting plan that is consistent with local ordinance policies regarding protected trees. The replacement tree planting plan will include sufficient replacement plantings and will effectively constitute a minimum of inch-for-inch replacement for protected trees that are damaged or removed as a result of the proposed project. Replacement trees planted on site will not be planted until completion of project construction and will be monitored for a period of 10 years following installation; failed plantings will be replaced with new plantings until success criteria has been met. If on-site replanting commensurate with the number of trees being disturbed or removed is not feasible, the program proponent will use off-site mitigation (e.g., donation to the Sacramento Tree Foundation).

Effect VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction

Invasive plants are already present in the study area. However, the locations and distributions of the invasive plants in the study area are not wholly known at this time, because site specific surveys have not yet been performed and there is no existing fine-scale invasive plant data available for the entire study area at the current time. Construction activities associated with this treatment could introduce new invasive plants to the study area or contribute to the spread of existing invasive plants to uninfested areas outside the study area. Invasive plants or their seeds may be dispersed by construction equipment if appropriate prevention measures are not implemented. This impact is potentially significant because the introduction or spread of invasive plants as a result of the proposed program could have a substantial adverse effect on sensitive natural communities or special-status species within and outside the study area by displacing native flora. Implementation of Mitigation Measures VEG-MM-11, VEG-MM-12, and VEG-MM-13 would ensure that the proposed program would not have a substantial adverse effect on sensitive natural communities or special-status species from the introduction or spread of invasive plants, and that this effect would be less than significant.

Mitigation Measure VEG-MM-11: Conduct a Survey to Document Invasive Plant Infestations

As part of future project-level environmental review for program elements, the program proponent will retain a qualified botanist, weed ecologist, or landscape architect to address noxious weed impacts. This will allow the program proponent to implement Mitigation Measure

VEG-MM-12: Avoid and Minimize the Spread or Introduction of Invasive Plant Species, if necessary. The botanist/weed ecologist/landscape architect will determine whether noxious weeds are an issue for the project and whether they could displace native plants and natural habitats, affect the quality of forage on rangelands, or affect cropland productivity. If the botanist/weed ecologist/landscape architect determines that noxious weeds are an issue, the program proponent will review the appropriate county agricultural commissioner's noxious weed list, and lists of invasive plants maintained by the CDFA and Cal-IPC. These lists will be used to identify weeds that are considered locally important for documentation and control purposes, and which will be targeted during field surveys. A list of the target weeds will be provided to the botanist/weed ecologist/landscape architect prior to the field surveys.

If invasive plant infestations are located during the field surveys, they will be mapped and documented as part of CEQA and NEPA compliance. The program proponent will implement Mitigation Measure VEG-MM-12.

Mitigation Measure VEG-MM-12: Avoid and Minimize the Spread or Introduction of Invasive Plant Species

The program proponent will implement one or more of the following measures to avoid and minimize the spread or introduction of invasive plant species. In addition, the program proponent will coordinate with the appropriate county agricultural commissioner to ensure that the appropriate best management practices are implemented for the duration of the construction of proposed projects.

- Clean construction equipment and vehicles in a designated wash area prior to entering and exiting the project site.
- Educate construction supervisors and managers about invasive plant identification and the importance of controlling and preventing the spread of invasive plant infestations.
- Treat small, isolated infestations with eradication methods that have been approved by or developed in conjunction with the appropriate county agricultural commissioner to prevent and/or destroy viable plant parts or seeds.
- Minimize surface disturbance to the greatest extent feasible to complete the work.
- Use native, noninvasive species, and nonpersistent or sterile nonnative hybrids in erosion-control plantings to stabilize site conditions and prevent invasive plant species from colonizing.
- Use weed-free imported erosion-control materials (or rice straw in upland areas).

Mitigation Measure VEG-MM-13: Conduct a Follow-Up Weed Survey and Implement Eradication Methods if New Infestations Are Present

Approximately 1 year after construction, during the appropriate season, the program proponent will retain a qualified botanist, weed ecologist, or landscape architect to conduct a follow-up weed survey to determine if any new invasive plant infestations of the target weeds identified under VEG-MM-11 have become established. If new infestations are present, the program proponent will contact the appropriate county agricultural commissioner to determine appropriate eradication methods. The program proponent will implement those methods until the county agricultural commissioner determines that the new infestations have been successfully eradicated.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect VEG-1: Permanent Loss of Woody Riparian Vegetation Resulting from Compliance with the Vegetation ETL

Under Alternative 3A, either a setback levee would be constructed some distance behind the existing levee or an adjacent levee embankment would be constructed along the landside of the existing levee. In either case, the bank repair methods would shift the levee prism and VFZ landward. Within the VFZ of the new levee, the loss of vegetation would likely result in fewer effects as compared with Alternative 2A, though the degree of the effect would depend upon the type and extent of vegetation present within the levee construction area. Riparian habitat losses due to compliance with the Vegetation ETL under Alternative 3A have the potential to be significant, but implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4 would ensure that this effect is reduced to a level that is less than significant.

Effect VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction

This effect is similar to Effect VEG-2 described under Alternative 2A and is considered significant and unavoidable. However, the magnitude of Effect VEG-2 under Alternative 3A is expected to be substantially less than under Alternative 2A because substantially less vegetation overall, and as a result, less special-status plant populations, would be removed under Alternative 3A. Implementation of Mitigation Measures VEG-MM-2 and, if applicable, Mitigation Measures VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6 may avoid or reduce this effect to a less than significant level. Substantial losses of a listed plant could result in a significant effect. A further significance determination will be made on a site-specific basis during project-level implementation of the proposed program.

Effect VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction

Construction of setback levees and adjacent levees under Alternative 3A would, for the most part, allow woody vegetation along existing erosion repair sites to be retained. Where setback levees are constructed, the loss of habitats (particularly woody habitats) would likely result in substantially fewer effects on vegetation resources as compared with Alternative 2A because substantially less vegetation would need to be removed, though the degree of the effect would depend upon the type and extent of vegetation present within the setback levee construction area. The breaching of the existing levee and creation of an enlarged floodplain could provide moderate to substantial areas of new riparian vegetation (see beneficial effect, Effect-VEG-7), though the degree of the benefit would depend on the type of restoration that occurs within these new floodplain areas.

Where adjacent levees are constructed, woody vegetation along existing erosion repair sites would be retained along the waterside, though existing vegetation along the landside of the levee would be removed. Table 10-8 summarizes the amount of riparian vegetation that would be lost as a result of Effects VEG-1 and VEG-3.

Table 10-8. Summary of Site-Specific Vegetation Analysis for Alternative 3A (acres)

	Existing Vegetation		Removed Vegetation		Retained Vegetation		Plantable Area Created
Region	Woodland	Scrub	Woodland	Scrub	Woodland	Scrub	
Region 1a	11.48	6.01	3.67	0.83	7.81	5.17	14.04
Region 1b	10.26	2.11	1.27	0.00	9.00	2.11	0.48
Region 2	9.04	0.68	1.81	0.00	7.23	0.68	9.61
Region 3	4.94	0.00	0.02	0.00	4.92	0.00	2.86
Subtotal	35.72	8.80	6.77	0.83	28.95	7.97	
Total	44.52		7.60		36.92		26.99

Indirect effects are not expected under this alternative. The direct loss of approximately 7.6 acres of riparian vegetation is considered a significant effect because riparian vegetation is an important component of the riverine ecosystem. Riparian vegetation has been identified by state and federal resource agencies as having important value to wildlife, and very little remains in comparison with its historic extent. However, this would be compensated by the creation of approximately 27 acres of plantable area, allowing for on-site mitigation. With the implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4 this effect would be reduced to a level that is less than significant.

Effect VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction

This effect is similar to Effect VEG-4 as described under Alternative 2A and is considered significant. Implementation of mitigation measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8 would reduce this effect to a level that is less than significant.

Effect VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction

This effect is similar to Effect VEG-5 as described under Alternative 2A and is considered potentially significant. However, the magnitude of Effect VEG-5 under Alternative 3A is expected to be substantially less than under Alternative 2A because substantially less vegetation would need to be removed under Alternative 3A. Implementation of Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-9, and, if necessary, VEG-MM-10 would reduce this effect to a level that is less than significant.

Effect VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction

This effect is the same as described under Alternative 2A and is considered potentially significant. Implementation of Mitigation Measures VEG-MM-11, VEG-MM-12, and VEG-MM-13 would reduce this effect to a level that is less than significant.

Effect VEG-7: Potential Opportunity for Habitat Restoration in Enlarged Floodplain following Program Construction

If the existing levee is breached in several places during installation of setback levees, the enlarged floodplains created between the water's edge and setback levee could be dedicated to habitat restoration (e.g., riparian habitat) and revegetated accordingly. However, the land use in the new floodplains would be determined on a site-by-site basis. The program proponent could retain a qualified restoration ecologist or landscape architect to develop a restoration plan that would ensure the long-term duration of the function and value of the restored habitat. Therefore, this effect would be beneficial.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect VEG-1: Permanent Loss of Woody Riparian Vegetation Resulting from Compliance with the Vegetation ETL

Under Alternative 4A, all of the available bank protection measures would be utilized to varying extents (see Table 2-2). While Bank Protection Measure 2 would remove all vegetation within the project footprint, the remaining bank protection measures would retain vegetation to the extent feasible and consistent with the Vegetation ETL and/or create plantable space that would support riparian vegetation. As previously discussed in Chapter 2, Project Description, the goal of Alternative 4 is to replace the existing habitat, with an emphasis on vegetation that is beneficial to target fish species, while at the same time protecting the bank from erosion.

The amount of woody riparian vegetation removed under Alternative 4A due to compliance with the Vegetation ETL would be less than under Alternative 2A but more than under Alternative 3A. These losses have the potential to be significant, but the creation of plantable space at many of the sites and implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4 would ensure that this effect would be reduced to a level that is less than significant. Off-site mitigation may be required if on-site mitigation alone cannot achieve the required compensation ratio, and would be provided as described in Mitigation Measure VEG-MM-1.

Effect VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction

This effect is similar to Effect VEG-2 described under Alternatives 2A and 3A and is considered significant. The magnitude of Effect VEG-2 under Alternative 4A is expected to be less than under Alternative 2A, but greater than under 3A. Implementation of Mitigation Measure VEG-MM-2 and, if applicable, Mitigation Measures VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6 would potentially avoid or reduce this effect to a less than significant level. Substantial losses of a listed plant could result in a significant and unavoidable effect. The final significance determination would need to be made on a site-specific basis during project-level implementation of the proposed program.

Effect VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction

Under Alternative 4A, riparian habitat that occurs outside of the VFZ but within each site's project footprint would be removed where specific bank protection measures are constructed based on the analysis previously described. Where setback levees and adjacent levees (Bank Protection Measures 1 and 3, respectively) are constructed, the types of effects on vegetation would be similar to that described above for Alternative 3A. Bank Protection Measure 2, which would be used sparingly under Alternative 4A, would remove all vegetation within an erosion site's construction and access footprint. Bank Protection Measures 4a through 4c would involve the removal of vegetation but also include the creation of benches that are specifically designed to support the creation of riparian vegetation. Bank Protection Measure 5, which does not include a riparian bench, would allow for some vegetation planting along its slope in areas consistent with the Vegetation ETL. While the actual quantity of vegetation loss outside of the VFZ but within the project footprint may be reduced with avoidance measures applied on a site-by-site basis during implementation, Table 10-9 summarizes the amount of riparian vegetation that would be lost as a result of Effects VEG-1 and VEG-3. The removal of riparian habitat under Alternative 4A would have a significant effect.

As previously identified in Effect FCGEOM-1, there could be indirect effects to areas upstream and downstream of an erosion site including indirect effects on vegetation. However, implementation of Mitigation Measure FCGEOM-MM-1 would ensure that indirect effects, including those on vegetation, would be avoided or be less than significant

Table 10-9. Summary of Site-Specific Vegetation Analysis for Alternative 4A (acres)

	Existing Vegetation		Removed Vegetation		Retained Vegetation		Plantable Area Created
Region	Woodland	Scrub	Woodland	Scrub	Woodland	Scrub	
Region 1a	11.48	6.01	4.16	1.28	7.32	4.72	14.56
Region 1b	10.26	2.11	6.80	1.97	3.46	0.15	1.95
Region 2	9.04	0.68	6.39	0.68	2.65	0.00	7.85
Region 3	4.94	0.00	3.94	0.00	1.00	0.00	1.19
Subtotal	35.72	8.80	21.29	3.93	14.43	4.87	
Total	44.52		25.22		19.30		25.55

Slightly more than 25 acres would be directly affected and removed, which would be considered significant. However, an almost equal amount of plantable area would be created, and implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4 would ensure that this effect is reduced to a level that is less than significant. It is important to note that the acreage of the removed vegetation represents actual vegetation canopy. The plantable area may or may not support that same amount of canopy, depending on site-specific design and planting densities, and reaching 100% canopy coverage is oftentimes not feasible. Off-site mitigation may be required if on-site mitigation alone cannot achieve the required compensation ratio and would be provided as previously described in Mitigation Measure VEG-MM-1.

Effect VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction

This effect is similar to Effect VEG-4 as described under Alternative 2A and is considered significant. Implementation of Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8 would reduce this effect to a level that is less than significant.

Effect VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction

This effect is similar to Effect VEG-5 as described under Alternative 2A and is considered potentially significant. Implementation of Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-9, and, if necessary, VEG-MM-10 would reduce this effect to a level that is less than significant.

Effect VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction

This effect is the same as described under Alternative 2A and is considered potentially significant. Implementation of Mitigation Measures VEG-MM-11, VEG-MM-12, and VEG-MM-13 would reduce this effect to a level that is less than significant.

Effect VEG-7: Potential Opportunity for Habitat Restoration in Enlarged Floodplain following Program Construction

For sites where a setback levee would be constructed, this effect is the same as described under Alternative 3A and is considered beneficial.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect VEG-1: Permanent Loss of Woody Riparian Vegetation from Compliance with the Vegetation ETL

Under Alternative 5A, all of the available bank protection measures would be utilized to varying extents (see Table 2-2 in Chapter 2). Although Bank Protection Measure 2 would remove all vegetation within the project footprint, the remaining bank protection measures would retain vegetation to the extent feasible and consistent with the Vegetation ETL and/or create plantable space that would support riparian vegetation. As previously discussed in Chapter 2, the goal of Alternative 5 is to reach "environmental neutrality" with regard to existing habitat, with an emphasis on vegetation that is beneficial to target fish species, while at the same time protecting the bank from erosion. In this case, "environmental neutrality" refers specifically to fish habitat as evaluated using the Standard Assessment Methodology (SAM) (as described in Chapter 11, Fisheries and Aquatics) and riparian habitat. The proposed program will be considered to meet "environmental neutrality" if the SAM values for the alternative are zero or greater (positive) and the amount of vegetation removed can be adequately replaced on-site or within other program sites within the same region (e.g., 1a, 1b, 2, or 3).

The amount of woody riparian vegetation removed under Alternative 5A due to compliance with the Vegetation ETL would be similar to, though slightly less than, under Alternative 4A. These losses have the potential to be significant, but the creation of plantable space at many of the sites and implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4 would ensure that this effect is reduced to a level that is less than significant. Off-site mitigation may be required if on-site mitigation alone cannot achieve the required compensation ratio and would be provided as described in Mitigation Measure VEG-MM-1.

Effect VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction

This effect is similar to Effect VEG-2 described under Alternative 4A and is considered significant. However, the magnitude of Effect VEG-2 under Alternative 5A is expected to be slightly less than under Alternative 4A. Implementation of Mitigation Measure VEG-MM-2 and, if applicable, Mitigation Measures VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6 may avoid or reduce this effect to a less than significant level. Substantial losses of a listed plant could result in a significant and unavoidable effect. A further significance determination will be made on a site-specific basis during project-level implementation of the proposed program.

Effect VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction

Under Alternative 5A, riparian habitat that occurs outside of the VFZ but within each site's construction footprint would be removed based on the analysis assumptions previously described. This effect is similar to Effect VEG-3 as described under Alternative 4A. Where setback levees and adjacent levees (Bank Protection Measures 1 and 3, respectively) are constructed, the types of effects on vegetation would be similar to that described above for Alternative 3A. Bank Protection Measure 2, which would be used very sparingly under Alternative 5A, would remove all vegetation within an erosion site's construction and access footprint, and its effects would be similar to those described under Alternative 2A. Bank Protection Measures 4a through 4c would involve the removal of vegetation but also include the creation of benches that are specifically designed to support the creation of riparian vegetation. Bank Protection Measure 5, while it does not include a riparian bench, allows for some vegetation planting along its slope in areas consistent with the Vegetation ETL. While the actual quantity of vegetation loss outside of the VFZ but within the project footprint may be less as a result of avoidance measures applied on a site-by-site basis during implementation, Table 10-10 summarizes the amount of riparian vegetation that would be lost as a result of Effects VEG-1 and VEG-3.

Table 10-10. Summary of Site-Specific Vegetation Analysis for Alternative 5A (acres)

	Existing Vegetation		Removed Vegetation		Retained Vegetation		Plantable Area Created
Region	Woodland	Scrub	Woodland	Scrub	Woodland	Scrub	
Region 1a	11.48	6.01	4.16	0.98	7.32	5.03	16.11
Region 1b	10.26	2.11	5.03	0.84	5.23	1.27	1.88
Region 2	9.04	0.68	6.21	0.68	2.82	0.00	16.28
Region 3	4.94	0.00	0.38	0.00	4.56	0.00	5.49
Subtotal	35.72	8.80	16.66	2.50	19.95	8.30	
Total	44.52		18.27		26.25		39.76

As previously identified in Effect FCGEOM-1, there could be indirect effects to areas upstream and downstream of an erosion site including indirect effects on vegetation. However, implementation of Mitigation Measure FCGEOM-MM-1 would ensure that indirect effects, including those on vegetation, would be avoided or be less than significant.

Slightly more than 18 acres of vegetation would be directly affected and removed, which would be considered a significant effect because riparian vegetation is an important component of the riverine ecosystem. Riparian vegetation has been identified by state and federal resource agencies as having important value to wildlife, and very little remains in comparison with its historic extent. However, implementation of the environmentally neutral alternative would create a greater amount of plantable space (nearly 40 acres) than was lost, and implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4 would ensure that this effect is reduced to a level that is less than significant. The ability of this amount of created plantable area to fully mitigate for effects would depend on site-specific designs and planting densities. It is important to note that the acreage of the removed vegetation represents actual vegetation canopy. The plantable area may or may not support that same amount of canopy, depending on site-specific design and planting densities. Reaching 100% canopy coverage is oftentimes not feasible. Off-site mitigation may be required as previously described in VEG-MM-1, and would be provided as described in Mitigation Measure VEG-MM-1.

Effect VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction

This effect is similar to Effect VEG-4 as described under Alternative 2A and is considered significant. Implementation of Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8 would reduce this effect to a level that is less than significant.

Effect VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction

This effect is similar to Effect VEG-5 as described under Alternative 2A and is considered potentially significant. Implementation of Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-9, and, if necessary, VEG-MM-10 would reduce this effect to a level that is less than significant.

Effect VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction

This effect is the same as described under Alternative 2A and is considered potentially significant. Implementation of Mitigation Measures VEG-MM-11, VEG-MM-12, and VEG-MM-13 would reduce this effect to a level that is less than significant.

Effect VEG-7: Potential Opportunity for Habitat Restoration in Enlarged Floodplain following Program Construction

For sites where a setback levee would be constructed, this effect is the same as described under Alternative 3A and is considered beneficial.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect VEG-1 would not apply to Alternative 6A because this alternative would obtain a variance from the Vegetation ETL, and removal of vegetation in the VFZ would not be implemented.

Effect VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction

This effect is similar to Effect VEG-2 described under Alternative 4A and is considered significant. Implementation of Mitigation Measures VEG-MM-2 and, if applicable, Mitigation Measures VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6 may result in avoidance of this effect or reduce this effect to a level that is less than significant. Substantial losses of a listed plant could result in a significant and unavoidable effect. Further significance determinations will be made on a site-specific basis during project-level implementation of the proposed program.

Effect VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction

Under Alternative 6A, all of the available Bank Protection Measures 1, 4a, 4b, 4c, and 5 would be utilized to varying extents (see Table 2-2 in Chapter 2). Although Bank Protection Measure 2 would remove all vegetation within the construction footprint, the remaining bank protection measures would retain vegetation to the extent feasible and/or create plantable space that would support riparian vegetation. As previously discussed in Chapter 2, the goal of Alternative 6 is to retain as much vegetation as feasible, through use of a variance from the Vegetation ETL.

In the limited situations where setback levees would be constructed under Alternative 6A, the types of effects on vegetation would be similar to those described above for Alternative 3A. Bank Protection Measures 4a through 4c would involve the removal of vegetation but also include the creation of benches that are specifically designed to support the creation of riparian vegetation. Bank Protection Measure 5, which does not include a riparian bench, does allow for some vegetation planting along its slope in areas consistent with the Vegetation ETL. While the actual quantity of vegetation loss outside of the VFZ but within the project footprint may be reduced as a result of avoidance measures applied on a site-by-site basis during implementation, Table 10-11 summarizes the amount of riparian vegetation that would be lost as a result of Effect VEG-3.

Table 10-11. Summary of Site-Specific Vegetation Analysis for Alternative 6A (acres)

Region	Existing Vegetation		Removed Vegetation		Retained Vegetation		Plantable Area Created
	Woodland	Scrub	Woodland	Scrub	Woodland	Scrub	
Region 1a	11.48	6.01	4.03	3.39	7.45	2.62	8.01
Region 1b	10.26	2.11	5.62	1.61	4.64	0.51	2.59
Region 2	9.04	0.68	5.14	0.68	3.90	0.00	7.85
Region 3	4.94	0.00	3.95	0.00	0.99	0.00	1.19
Subtotal	35.72	8.80	18.75	5.68	16.97	3.12	
Total	44.52		24.43		20.09		19.65

As previously identified in Effect FCGEOM-1, there could be indirect effects to areas upstream and downstream of an erosion site including indirect effects on vegetation. However, implementation of Mitigation Measure FCGEOM-MM-1 would ensure that indirect effects, including those on vegetation, would be avoided or be negligible.

Approximately 24.5 acres of vegetation would be directly affected and removed, which would be considered a significant effect because riparian vegetation is an important component of the riverine ecosystem. Riparian vegetation has been identified by state and federal resource agencies as having important value to wildlife, and very little remains in comparison with its historic extent. However, implementation of Alternative 6A would create approximately 19.5 acres of plantable area. The planting of 19.5 acres is not likely to fully mitigate for effects; therefore, off-site mitigation may be required and would be provided as described in Mitigation Measure VEG-MM-1. With mitigation, the effect would be less than significant.

Effect VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction

This effect is similar to Effect VEG-4 as described under Alternative 2A and is considered significant. Implementation of Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8 would reduce this effect to a level that is less than significant.

Effect VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction

This effect is similar to Effect VEG-5 as described under Alternative 2A and is considered potentially significant. Implementation of Mitigation Measures VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-9, and, if necessary, VEG-MM-10 would reduce this effect to a level that is less than significant.

Effect VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction

This effect is the same as described under Alternative 2A and is considered potentially significant. Implementation of Mitigation Measures VEG-MM-11, VEG-MM-12, and VEG-MM-13 would reduce this effect to a level that is less than significant.

Effect VEG-7: Potential Opportunity for Habitat Restoration in Enlarged Floodplain following Program Construction

For sites where a setback levee would be constructed, this effect is the same as described under Alternative 3A and is considered beneficial.

Chapter 11
Fisheries and Aquatics

Introduction and Summary

This chapter describes the environmental setting associated with fisheries and aquatics, the determination of effects, the environmental effects on fisheries and aquatics that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects. This chapter does not address take of critical habitat or take of endangered species. Those topics are addressed in the Programmatic Biological Assessment identified below.

The key sources of data and information used in the preparation of this chapter are listed below.

- Programmatic Biological Assessment for the Sacramento River Bank Protection Project. Administrative draft report (Stillwater Sciences 2007).
- Standard Assessment Methodology for the Sacramento River Bank Protection Project (U.S. Army Corps of Engineers 2004).
- Section 7 Programmatic Formal Consultation on the Sacramento River Bank Protection Project Phase II, Contra Costa, Sacramento, Solano, Sutter, Yolo, Yuba, Placer, San Joaquin, Butte, Colusa, Glenn, and Tehama Counties, California (U.S. Fish and Wildlife Service 2008).
- Programmatic Consultation for Phase II of the Sacramento River Bank Protection Project (National Marine Fisheries Service 2008a).
- Published and unpublished scientific reports and peer-reviewed literature.

Table 11-1 summarizes the fisheries and aquatics effects resulting from the implementation of the program alternatives.

Table 11-1. Summary of Fisheries and Aquatics Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
Effect FISH-1: Short-Term Effects of Rock Placement into Nearshore Aquatic Habitat during Construction	FISH-MM-1: Limit Construction Activity to Periods of the Year That Minimize Effects on Fish	During construction
Effect FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction	WQ-MM-1: Monitor Turbidity during Construction FISH-MM-1: Limit Construction Activity to Periods of the Year That Minimize Effects on Fish	During construction
Effect FISH-3: Spillage and Leakage of Contaminants during Construction	WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality FISH-MM-1: Limit Construction Activity to Periods of the Year That Minimize Effects on Fish	Prior to and during construction

Effect	Mitigation Measures	Implementation Period
Effect FISH-4: Long-Term Effects on Fish from Loss of Habitat	FISH-MM-2: Compensate for Loss of Fish Habitat FISH-MM-3: Compensate for the Loss of Spawning Habitat	During and after construction

Environmental Setting

The program area encompasses more than 1,000 miles of levees and weirs. This area extends south-to-north along the Sacramento River, from the town of Collinsville (RM 0) upstream to Chico at RM 194 (the levees end at RM 184). The program area also includes Cache Creek, the lower reaches of Elder and Deer Creeks, the lower reaches of the American River (RM 0–23), Feather River (RM 0–61), Yuba River (RM 0–11), and Bear River (RM 0–17), portions of Threemile, Steamboat, Sutter, Miner, Georgiana, and Cache Sloughs, as well as a number of flood bypasses and distributaries.

Existing Conditions

The Sacramento River watershed receives winter/early spring precipitation in the form of rain and snow (at higher elevations). Prior to the construction and operation of any reservoirs, winter rainfall events caused extensive flooding and spring snowmelt resulted in high flows during spring and early summer. Summer and fall flows were historically low. Currently, much of the total runoff is captured and stored in reservoirs for gradual release during the summer and fall months. High river flows occur during the winter and spring, but these are usually lower than during pre-European settlement times; summer and fall low flows are sustained by releases from upstream reservoirs.

Sacramento River

In pre-settlement times, the Sacramento River's floodplain was occupied by dense riparian forest, likely extending a few miles from the river until wetland and marsh communities of the Natomas Basin prevailed to the east and Yolo Basin to the west. The remnant riparian forest above the bank protection sites generally supports the same species as were present in the pre-settlement period.

Because of clearing for agriculture, the riparian forest corridor along the Sacramento River is discontinuous and highly variable in width, species dominance, and ecological integrity. In reaches some distance upstream of the Fremont Weir, as well as through Sacramento and downstream through the Delta, forest gaps dominate over patches, and long lengths of the riverbank are nearly devoid of woody vegetation. Above Colusa a vast, dynamic riparian forest generally dominates the riverine landscape, although it is fragmented from place to place by agriculture.

The riparian corridor along the Sacramento River is generally continuous, narrow—but sufficiently wide to be considered a *corridor* rather than a *strand*—and dominated by diverse native woody species. Although narrow, it provides functional riparian habitat and undoubtedly serves as reproduction and foraging habitat and as a corridor for dispersal and migration for several species. This native riparian vegetation patch extends from the urban Sacramento limits to upstream riparian corridors along both the Sacramento and Feather Rivers at and above their confluence and the Fremont Weir overflow to the Yolo Basin.

The Sacramento River serves as an important migration and juvenile rearing corridor for anadromous fish species, which have been the focus of many restoration programs for the Sacramento River system. Anadromous steelhead and Chinook salmon, as well as resident green sturgeon, are endangered fish species known to use the program area. Habitat suitability for juveniles of these species is characterized by several variables, assessed for flow levels during seasons when juvenile salmonids pass through the sites: amount of nearshore shallow-water zones, presence of instream vegetation and instream woody material (IWM) in these zones, amount of shading bank vegetation over these zones, substrate type, and amount of adjacent floodplain during frequent flood flows (i.e., 1.5- to 3-year return period).

The Sacramento River supports the following fish species listed under the federal Endangered Species Act (ESA): Central Valley steelhead, Central Valley fall-, late fall–, and spring-run Chinook salmon, Sacramento winter-run salmon, delta smelt, and green sturgeon. Fish species protected under the California Endangered Species Act (CESA) include longfin smelt, Sacramento splittail, hardhead, and river lamprey.

Delta Sloughs

The major tidal sloughs within the program area are Threemile, Georgiana, Steamboat, Miner, Lindsay, Cache, Haas, and Sutter Sloughs. Sloughs and channels in this region are generally confined on both sides by natural levees enhanced by decades of man-made improvements. The individual channels and sloughs are moderately sinuous, of uniform width, and do not migrate.

The effects of seasonal flood events are much lesser in Delta sloughs than in the upper regions because of both tidal action and the diversion of flow through the upstream flood bypasses and outtakes (U.S. Fish and Wildlife Service 2001). Historically, channel and slough morphology actively adjusted throughout the Delta in response to seasonal variations in flow and sediment load. The decrease in flow velocities caused the deposition of a gradient of coarser to finer material from upstream to downstream (fine sand to clayey silt). The intertidal deposits that border the Delta channels and sloughs are typically characterized by shallow, alternating layers of fine sandy silt and clayey silt, with occasional peaty muds. Artificial fill from hydraulic dredge soils was placed after 1900 throughout the Delta along channel margins and upon various island surfaces (Atwater 1982).

The riparian community in the Delta has been altered significantly since pre-European settlement times. Broad floodplains near the Delta that were once occupied by tule marshes and vernal pools have become isolated from the channel because of revetment along the levees. Several patches of tule habitat still occur at the mouths of sloughs and several areas downstream of Rio Vista (RM 12–13). However, riparian vegetation along the major sloughs is restricted to scattered narrow bands typically less than 30 feet wide on banks, berms, and levee faces (U.S. Army Corps of Engineers 2004).

The Delta provides habitat for all special-status fish species (listed as threatened, endangered or species of concern under ESA or CESA) known to occur in the program area. Adult fish species migrate through the Delta to upstream areas of the Sacramento River and its tributaries and spawn in the river. Delta smelt, longfin smelt, green sturgeon and juvenile salmonids rear in the Delta.

Yolo, Sacramento, Tisdale, and Sutter Bypasses

Seasonal high flows from the Sacramento River enter the Yolo Bypass via the Sacramento Bypass (RM 63). To provide flood capacity, overflows at the Tisdale Weir (RM 119) are conveyed into the

Tisdale Bypass, which routes the water into the Sutter Bypass. Upstream of the reach, floodwaters may overflow the left bank into Butte Basin via three locations near Chico Landing and through the Moulton (RM 158) and Colusa (RM 146) Weirs. At extremely high river stages, floodwaters may also overflow the right bank of the river and drain into the Colusa Basin, which eventually connects to the Sacramento River and Yolo Bypass via the Colusa Main Drain (U.S. Army Corps of Engineers 2007).

When inundated during high winter and spring flows, the Yolo and Sacramento Bypasses provide migratory and rearing habitat for emigrating juvenile salmonids, green sturgeon, and river lamprey. Sacramento splittail also use the Yolo and Sacramento Bypasses for spawning and juvenile rearing.

American River

The American River is the second largest tributary of the Sacramento River. The American River is designated as a recreational river in the state and federal wild and scenic river systems. Below Nimbus Dam, the lower American River flows through a parkway, surrounded by urban development and is a major recreational area for the Sacramento region.

The lower American River provides a diversity of aquatic habitats, including shallow, fast-water riffles, glides, runs, pools, and off-channel backwater habitats. The lower American River from Nimbus Dam (RM 23) to approximately Goethe Park (RM 14) is primarily unrestricted by levees but is bordered by some developed areas. Natural bluffs contain this reach of the river and terraces cut into the side of the channel. The river reach downstream of Goethe Park, and extending to its confluence with the Sacramento River (RM 0), is bordered by levees. The construction of levees changed the channel geomorphology and has reduced river meanders and increased depth (U.S. Bureau of Reclamation et al. 2003: 9-33).

The lower American River supports two special-status fish species: fall-run Chinook salmon and steelhead. The Central Valley fall-run Chinook salmon is currently designated a species of concern under ESA. The Central Valley steelhead is listed as threatened under ESA. The American River also supports a mixed run of hatchery and naturally produced fall-run Chinook salmon. On average, tens of thousands of hatchery or naturally produced Chinook salmon return each year to spawn.

Feather River

The Feather River drains 3,222 square miles of land base from the Sierra crest westward into the Sacramento River. The Feather River has a relatively large drainage basin along the Sierra foothills that receives input from several key tributaries, including Honcut Creek, the Yuba River, and the Bear River. Approximately 67 miles downstream of the City of Oroville, the Feather River flows into the Sacramento River, near the town of Verona, about 21 river miles upstream of Sacramento (California Department of Water Resources 2007). The program area extends from the confluence of the Sacramento River (Feather River Mile 0) to RM 61.

The Feather River watershed has been affected by 140 years of intense human use. Past mining, grazing and timber harvest practices, wildfire, and railroad and road construction have contributed to the degradation of more than 60% of the watershed, resulting in accelerated erosion, degraded water quality, decreased vegetation and soil productivity, and degraded terrestrial and aquatic habitats (Feather River Coordinated Resource Management 2009).

The lower Feather River from the Fish Barrier Dam to Honcut Creek supports a variety of anadromous and resident fish species. The Feather River maintains spawning, rearing, and migration habitat for four special-status species: fall-run Chinook salmon, spring-run Chinook salmon, Central Valley steelhead, and Sacramento splittail (California Department of Water Resources 2001). The occasional capture of larval green sturgeon in outmigrant traps suggests that green sturgeon spawn in the Feather River (Moyle 2002). However, Adams et. al (2002) report that evidence of green sturgeon spawning in the Feather River is unsubstantiated. The National Marine Fisheries Service (NMFS) (2008b) states that the presence of adult, and possibly subadult, green sturgeon within the lower Feather River has been confirmed by incidental sightings (California Department of Water Resources 2005), photographs, anglers' descriptions of fish catches (P. Foley, pers. comm. cited in California Department of Fish and Game 2002), and occasional catches of green sturgeon reported by fishing guides (Beamesderfer et al. 2004).

Bear River

The Bear River is the second largest tributary of the Feather River. The Bear River has been heavily affected by water imports and diversions, barriers, gravel mining, and municipal and residential effluent (Johnson 2002).

Historically, the Bear River may have had a large fall-run Chinook salmon population (Johnson 2002). Anadromous fish have access to 15 miles of the Bear River, but the habitat is of limited quality because of inadequate stream flow. As a result, there are no self-sustaining populations of salmon in the Bear River. However, during heavy rain events, salmon and steelhead will migrate up and spawn in the lower Bear River (National Marine Fisheries Service 2001).

Yuba River

The Yuba River joins the Feather River near the City of Marysville (California Department of Water Resources 2007). The Yuba River Basin drains approximately 1,350 square miles of the western Sierra Nevada slope, including portions of Sierra, Placer, Yuba, and Nevada Counties (CALFED Bay-Delta Program 1999). The primary watercourses of the upper watershed are the South, Middle, and North Yuba Rivers, which flow into Englebright Reservoir, which then releases water into the lower Yuba River. Both the upper and lower watersheds (above and below Englebright Dam, respectively) have been extensively developed for water supply, hydropower production, and flood control. Operators of upper watershed projects include The Pacific Gas and Electric Company (PG&E), Nevada Irrigation District and Oroville-Wyandotte Irrigation District.

The lower Yuba River consists of the approximately 24-mile stretch of river extending from Englebright Dam, the first impassible fish barrier along the river, downstream to the confluence of the Feather River near Marysville (U.S. Bureau of Reclamation et al. 2003). Habitat near the confluence of the Feather River is deep, slow water and becomes more complex moving upstream. Riffles, pools, and runs are present up to Daguerre Dam, although water temperatures are warmer than upstream of Daguerre Dam. Most salmonid spawning and rearing occurs upstream of Daguerre Dam.

The Yuba River supports fall- and late fall–run Chinook salmon, a small run of spring-run Chinook salmon, and Central Valley steelhead. Lamprey are also present in the lower Yuba River. Five green sturgeon were observed below Daguerre Dam in 2006 and 2011 (National Marine Fisheries Service 2012).

Assessment of Fish Habitat

Historically, the floodplain provided areas for riparian vegetation recruitment and for rearing of special-status fish species. However, throughout the program area watersheds, altered flow regimes, flood control, and bank protection efforts have reduced sediment transport, channel migration and avulsion, and IWM recruitment, and have isolated the channel from its floodplain. Levees and armored banks prevent fish from accessing productive floodplain habitats and limit nutrient exchange between the river and flooded riparian areas (U.S. Army Corps of Engineers 2004). Reach-scale habitat features related to special-status fish species habitat requirements are discussed below.

The lowermost portion of the program area (Sacramento River RM 0–80) has limited channel margin and floodplain habitat, but includes the Sutter and Yolo bypasses. Seasonal inundation of these bypass areas provides highly productive rearing habitat for juvenile salmonids. However, the bypass flood control structures are only flooded under certain conditions (i.e., high flows) and may not provide floodplain habitat during the typical months of juvenile salmonid rearing. The floodplain access may not provide the same benefits as natural bank areas (U.S. Army Corps of Engineers 2004).

The Delta slough area between Sacramento River Mile 0 and RM 20 extends into the shallow, open-water estuarine habitat that defines the boundary between the fresh water and saltwater portions of the Delta. Although this area is used primarily as a migration corridor for anadromous fish, it provides habitat for delta smelt throughout most of the year. Depending on salinity, still water habitats such as backwaters, sloughs, agricultural drainage canals, and wetlands found on flooded Delta islands are used for spawning by delta smelt, and as rearing habitat by juvenile Chinook salmon and steelhead (U.S. Army Corps of Engineers 2004). Riprap habitat in the Delta appears to be dominated by introduced centrarchids such as bluegill and largemouth bass (Chotkowski 1999), which may prey on eggs and young of special-status fish species.

The middle portion of the program area (Sacramento River Miles 80–143) also has limited channel margin and floodplain habitats because of levees lining the bank. The reach remains important as an upstream and downstream migration corridor for anadromous fish such as Chinook salmon and steelhead. Although access to floodplains is limited to the locations of flood control weirs (e.g., Tisdale, Moulton, Butte Slough), flooded portions of the Sutter Bypass provide vast expanses of potential rearing habitat for juvenile salmonids. Because the flood control structures were not specifically designed for the same inundation timing typical of juvenile salmonid rearing, the floodplain access may not provide the same benefits as natural bank areas with no levees (U.S. Army Corps of Engineers 2004).

The uppermost portion of the program area (Sacramento River Miles 143–194) has good channel margin habitat and is important as juvenile rearing habitat for all fish species except delta smelt. Near-shore and secondary channel habitats offer hydraulic complexity, cover from predation, and food resources important to juvenile fish. Specific habitat characteristics that benefit juvenile Chinook salmon and steelhead include shallow water with cover provided by overhanging riparian and aquatic vegetation, and IWM (U.S. Army Corps of Engineers 2004).

Table 11-2 shows existing habitat conditions of the reaches throughout the program area and includes percentage of revetment, dominant bank type, slope, median substrate size, instream woody material, emergent vegetation, ground cover on shoreline, and overhead shading (U.S. Army Corps of Engineers 2007).

Table 11-2. Existing Conditions in Program Reaches

							Linear Distance of Bank Attribute Coverage in Feet			
Reach	Portion of Reach	Shoreline Length (feet)	Revetment Length (feet) (% Shoreline)	Dominant Bank Type (% of all Revetment)	Bank Slope (dW:dH)	Median Bank Substrate Size, D50 (inches)	Instream Woody Material (% Shoreline)	Emergent Vegetation (% Shoreline)	Ground Cover Vegetation (% Shoreline)	Shade from Overhead Cover (% Shoreline)
Sacramento River RM 0–20	Entire region	1,507,343	563,255 (37%)	Large rock, >20 in. (64%)	3.2	11.9	131,580 (9%)	133,857 (9%)	1,232,483 (82%)	205,395 (14%)
	Erosion sites	27,738	8,647 (31%)	Large rock, >20 in. (91%)	2.5	17.6	11,872 (43%)	3,891 (14%)	23,530 (85%)	12,208 (44%)
	Without erosion sites	1,479,604	554,608 (37%)	Large rock, >20 in. (63%)	3.2	11.8	119,708 (8.1%)	129,966 (9%)	1,208,953 (82%)	193,187 (13%)
Sacramento River RM 20–80 and American River	Entire region	977,301	532,970 (55%)	Large rock, >20 in. (66%)	2.4	12.2	126,212 (13%)	13,169 (1.3%)	757,199 (76%)	178,251 (18%)
	Erosion sites	28,092	8,506 (30%)	Large rock, >20 in. (64%)	2.3	5.9	10,664 (38%)	0 (0%)	23,607 (84%)	9,548 (34%)
	Without erosion sites	949,209	524,464 (55%)	Large rock, >20 in. (66%)	2.3	12.4	115,548 (12%)	13,169 (1.4%)	733,592 (83%)	168,703 (18%)
Sacramento River RM 80–143	Entire region	2,604,779	554,325 (21%)	Medium cobble, 6–10 in. (53%)	1.5	6.9	285,708 (11%)	13,402 (0.5%)	2,166,020 (83%)	413,254 (16%)
	Erosion sites	39,822	22,224 (56%)	Medium cobble, 6–10 in. (68%)	1.8	7.4	3,981 (10%)	12 (0.03%)	32,579 (82%)	3,553 (9%)
	Without erosion sites	2,564,957	532,100 (21%)	Medium cobble, 6–10 in. (52%)	1.5	6.8	281,727 (11%)	13,390 (0.5%)	2,133,442 (83%)	409,701 (16%)
Sacramento River RM 143–194	Entire region	678,724	107,084 (16%)	Medium rock, 12–20 in. (60%)	1.7	2.6	98,600 (15%)	2,126 (0.3%)	314,831 (46%)	145,593 (22%)
	Erosion sites	6,885	3,494 (51%)	Medium cobble, 6–10 in. (91%)	1.7	4.7	1,275 (19%)	0 (0%)	4,200 (61%)	1,242 (18%)
	Without erosion sites	671,839	103,523 (15%)	Medium rock, 12–20 in. (62%)	1.7	2.6	97,325 (15%)	2,126 (0.3%)	310,631 (46%)	144,351 (22%)
Delta Slough Reach	Entire reach	568,197	320,520 (56%)	Large rock, >20 in. (78%)	2.1	10.7	105,903 (19%)	52,294 (9%)	458,999 (81%)	166,219 (29%)
	Erosion sites	23,777	7,091 (30%)	Large rock, >20 in. (89%)	1.6	5.7	11,638 (49%)	3,010 (13%)	20,626 (87%)	12,199 (51%)
	Without erosion sites	544,420	313,429 (58%)	Large rock, >20 in. (77%)	2.1	11.0	94,265 (17%)	49,284 (9%)	438,373 (81%)	154,019 (28%)

Reach	Portion of Reach	Shoreline Length (feet)	Revetment Length (feet) (% Shoreline)	Dominant Bank Type (% of all Revetment)	Bank Slope (dW:dH)	Median Bank Substrate Size, D50 (inches)	Linear Distance of Bank Attribute Coverage in Feet			
							Instream Woody Material (% Shoreline)	Emergent Vegetation (% Shoreline)	Ground Cover Vegetation (% Shoreline)	Shade from Overhead Cover (% Shoreline)
Bypass Reach	Entire reach	775,633	159,615 (21%)	Medium rock, 12–20 in. (49%)	3.0	2.5	26,804 (4%)	8,708 (1%)	651,734 (84%)	19,280 (3%)
Yolo Bypass Tributaries	Entire reach	284,152	34,550 (12%)	Small rock, <12 in. (90%)	2.7	0.9	1,184 (0.4%)	2,097 (1%)	244,739 (86%)	2,267 (1%)
	Erosion sites	2,193	0 (0%)	Natural bank (100%)	2.9	0.3	0 (0%)	0 (0%)	1,747 (80%)	9 (0.4%)
	Without erosion sites	281,959	34,550 (12%)	Small rock, <12 in. (90%)	2.7	0.9	1,184 (0.4%)	2,097 (1%)	242,992 (86%)	2,258 (1%)
Canal Reach	Entire reach	746,539	13,393 (2%)	Medium rock, 12–20 in. (54%)	2.7	0.5	6,682 (1%)	14,054 (2%)	645,514 (87%)	10,894 (2%)
Feather River and Tributaries	Entire reach	895,895	73,669 (8%)	Medium cobble, 6–10 in. (37%)	2.1	1.4	149,779 (17%)	6,575 (1%)	694,710 (78%)	264,129 (30%)
	Erosion sites	8,346	1,256 (15%)	Large rock, >20 in. (97%)	2.3	3.2	2,619 (31%)	13 (0.1%)	6,396 (77%)	2,269 (27%)
	Without erosion sites	887,549	72,413 (8%)	Medium cobble, 6–10 in. (38%)	2.1	1.4	147,160 (17%)	6,563 (1%)	688,314 (78%)	261,860 (30%)
Upper Sacramento River Tributaries	Entire reach	260,243	17,881 (7%)	Medium cobble, 6–10 in. (41%)	2.7	0.9	892 (0.3%)	2,126 (1%)	148,179 (57%)	11,833 (5%)

In. = inches.

Source: U.S. Army Corps of Engineers 2007

Status and Occurrence of Fish Species

Special-status fish species (listed as threatened, endangered or species of concern under ESA or CESA) that are known to occur in the program area are shown in Table 11-3.

Table 11-3. Special-Status Fish Species with the Potential to Occur in the Program Area

Species Name	Status[a] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Program Area	Critical habitat designated
Central Valley spring-run Chinook salmon *Oncorhynchus tshawytscha*	T/CT	Upper Sacramento River and Feather River	Occurs in well-oxygenated, cool, riverine habitat with water temperatures from 8.0 to 12.5°C. Coldwater pools are needed for holding adults (Moyle 2002).	High – documented occurrences in the program area.	Yes
Sacramento River winter-run Chinook salmon *Oncorhynchus tshawytscha*	E/CE	Mainstem Sacramento River below Keswick Dam (Moyle 2002)	Occurs in well-oxygenated, cool, riverine habitat with water temperatures from 8.0 to 12.5°C. Habitat types are riffles, runs, and pools (Moyle 2002).	High – documented occurrences in the program area.	Yes
Central Valley fall- and late fall–run Chinook salmon *Oncorhynchus tshawytscha*	SC/CSC	Sacramento and San Joaquin Rivers and tributary Central Valley rivers	Occurs in well-oxygenated, cool, riverine habitat with water temperatures from 8.0 to 12.5°C. Habitat types are riffles, runs, and pools (Moyle 2002).	High – documented occurrences in the program area.	No
Central Valley steelhead *Oncorhynchus mykiss*	T/–	Sacramento River and tributary Central Valley rivers	Occurs in well-oxygenated, cool, riverine habitat with water temperatures from 7.8 to 18°C (Moyle 2002). Habitat types are riffles, runs, and pools.	High – documented occurrences in the program area.	Yes
Green sturgeon (southern DPS) *Acipenser medirostris*	T/CSC	Sacramento, Klamath and Trinity Rivers (Moyle 2002)	Spawn in large river systems with well-oxygenated water, with temperatures from 8.0 to 14°C.	High – documented occurrences in the program area.	Yes
Delta smelt *Hypomesus transpacificus*	T/CE	Primarily in the Sacramento–San Joaquin estuary, but has been found as far upstream as the mouth of the American River on the Sacramento River and Mossdale on the San Joaquin River; range extends downstream to San Pablo Bay	Occurs in estuary habitat in the Delta where fresh and brackish water mix in the salinity range of 2–7 parts per thousand (Moyle 2002).	High – documented occurrences in the program area in the lower Sacramento River.	Yes

Species Name	Status[a] Fed/ State	Distribution	Habitat	Likelihood of Occurrence in the Program Area	Critical habitat designated
Longfin smelt *Spirinchus thaleichthys*	–/T	Within California, mostly in the Sacramento–San Joaquin Delta, but also in Humboldt Bay, Eel River estuary, and Klamath River estuary.	Salt or brackish estuary waters with freshwater inputs for spawning.	High – documented occurrences in the program area in the lower Sacramento River.	No
Sacramento splittail *Pogonichthys macrolepidotus*	–/CSC	Occurs throughout the year in low-salinity waters and freshwater areas of the Sacramento–San Joaquin Delta, Yolo Bypass, Suisun Marsh, Napa River, and Petaluma River (Moyle 2002).	Spawning takes place among submerged and flooded vegetation in sloughs and the lower reaches of rivers.	High – documented occurrences in the program area.	No
Hardhead (*Mylopharodon conocephalus*)	–/CSC	Tributary streams in the San Joaquin drainage; large tributary streams in the Sacramento River and the main stem.	Reside in low to mid-elevation streams and prefer clear, deep pools and runs with slow velocities. Also occur in reservoirs.	High – documented occurrences in the program area.	No
River lamprey *Lampetra ayresi*	–/CSC	Sacramento, San Joaquin, and Napa Rivers; tributaries of San Francisco Bay (Moyle 2002; Moyle et al. 1995)	Adults live in the ocean and migrate into fresh water to spawn	High – documented occurrences in the program area.	No

[a] Status:

Federal

E = Listed as endangered under the federal Endangered Species Act (ESA).
T = Listed as threatened under ESA.
SC = Listed as a species of concern.
– = No federal status.

State

CE = Listed as endangered under the California Endangered Species Act (CESA).
CT = Listed as threatened under CESA.
CSC = California species of special concern.
– = No state status.

Chinook salmon, steelhead, green sturgeon, delta smelt, longfin smelt and splittail have experienced declines in abundance as a result of natural and human-related factors. Major factors that contributed to the decline of salmon and steelhead include blockage of fish from spawning and rearing habitat by dams, deleterious water temperature, altered flows and flow fluctuations downstream of dams, entrainment in unscreened and poorly screened diversions, previous hatchery practices, and harvest (Busby et al. 1996; Good et al. 2005). Declines in green sturgeon populations may be a result of loss of spawning grounds, deleterious water temperature, entrainment, and toxins (Adams et al. 2002, 19). The decline in delta smelt abundance has been attributed to reduced Delta outflow, entrainment losses to water diversions, changes in food organisms, toxic substances, disease, competition and predation by nonnative species, and potential inbreeding with the nonnative wakasagi. Splittail have been adversely affected by loss of floodplain attributable to levees and channelization (Moyle 2002).

Other species that occur in Central Valley streams and rivers are white sturgeon, striped bass, American shad, largemouth bass, and several species of minnows, sunfish, and catfish (see Table 11-4. The lower portions of Central Valley rivers and the Delta are dominated by nonnative species, a contributing factor in the decline in abundance of native species (Moyle 2002).

Life Histories of Special-Status Fish Species

Chinook Salmon

Chinook salmon are anadromous fish, meaning that adults live in marine environments and return to their natal freshwater streams to spawn. Juveniles rear in freshwater for a period of up to 1 year until smoltification (i.e., a physiological preparation for survival in marine environs) and subsequent ocean residence.

Four distinct runs of Chinook salmon occur in the Sacramento River system: winter-run, spring-run, fall-run, and late fall–run. The runs are named after the season of adult migration, with each run having a distinct combination of adult migration, spawning, juvenile residency, and smolt migration periods. In general, fall- and late fall–run Chinook salmon spawn soon after entering their natal streams, while spring- and winter-run Chinook salmon typically hold in their natal streams for up to several months before spawning.

All four Central Valley Chinook salmon runs are subject to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and their harvest is regulated by the Pacific Coast Salmon Fishery Management Plan (salmon FMP). The salmon FMP includes designation of essential fish habitat (EFH) and requires consultation with NMFS if a project or action would potentially affect EFH. All of the program areas are within EFH for all four Chinook salmon runs (Pacific Fishery Management Council 1999).

Winter-Run

Both ESA and CESA list the winter-run Chinook salmon Evolutionarily Significant Unit (ESU) as an endangered species. Critical habitat for winter-run Chinook salmon includes the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) in the Delta (National Marine Fisheries Service 1997).

Table 11-4. Central Valley Fish Species Potentially Affected by the Proposed Program

Common Name—Origin	Scientific Name
Lamprey (two species)—native	*Lampetra* spp.
Chinook salmon (winter, spring, fall-, and late fall–runs)—native	*Oncorhynchus tshawytscha*
Chum salmon (rare)—native	*Oncorhynchus keta*
Steelhead/rainbow trout—native	*Oncorhynchus mykiss*
White sturgeon—native	*Acipenser transmontanus*
Green sturgeon—native	*Acipenser medirostris*
Delta smelt—native	*Hypomesus transpacificus*
Wakasagi—nonnative	*Hypomesus nipponensis*
Sacramento sucker—native	*Catostomus occidentalis*
Sacramento pikeminnow—native	*Ptychocheilus grandis*
Sacramento splittail—native	*Pogonichthys macrolepidotus*
Sacramento blackfish—native	*Orthodon microlepidotus*
Hardhead—native	*Mylopharodon conocephalus*
Speckled dace—native	*Rhinichthys osculus*
California roach—native	*Lavinia symmetricus*
Hitch—native	*Lavina exilicauda*
Golden shiner—nonnative	*Notemigonus crysoleucas*
Fathead minnow—nonnative	*Pimephales promelas*
Goldfish—nonnative	*Carassius auratus*
Carp—nonnative	*Cyprinus carpio*
Threadfin shad—nonnative	*Dorosoma petenense*
American shad—nonnative	*Alosa sapidissima*
Black bullhead—nonnative	*Ameiurus melas*
Brown bullhead—nonnative	*Ameiurus nebulosus*
White catfish—nonnative	*Ameiuruscatus*
Channel catfish—nonnative	*Ictalurus punctatus*
Mosquito fish—nonnative	*Gambusia affinis*
Inland silverside—nonnative	*Menidia audena*
Threespine stickleback—native	*Gasterosteus aculaetus*
Striped bass—nonnative	*Morone saxatilis*
Bluegill—nonnative	*Lepomis macrochirus*
Green sunfish—nonnative	*Lepomis cyanellus*
Redear sunfish—nonnative	*Lepomis microlophus*
Warmouth—nonnative	*Lepomis gulosus*
White crappie—nonnative	*Pomoxis annularis*
Black crappie—nonnative	*Pomoxis nigromaculatus*
Largemouth bass—nonnative	*Micropterus salmoides*
Redeye bass—nonnative	*Micropterus coosae*
Spotted bass—nonnative	*Micropterus punctulatus*
Small mouth bass—nonnative	*Micropterus dolomieu*
Bigscale logperch—nonnative	*Percina macrolepida*
Prickly sculpin—native	*Cottus asper*
Tule perch—native	*Hysterocarpus traski*

Historically, winter-run Chinook salmon spawned in cold tributary streams upstream of present-day Shasta Reservoir, including the Little Sacramento, Pit, McCloud, and Fall Rivers and Battle Creek. Presently, winter-run Chinook salmon persist in the Sacramento River below Keswick Dam and are sustained by coldwater releases from Shasta Reservoir. The upper Sacramento River is the only spawning area used by winter-run, although occasional strays have been reported in Battle Creek and Clear Creek.

Adult winter-run Chinook salmon immigration (upstream migration) through the Delta and into the Sacramento River occurs from December through July, with peak immigration from January through April. Winter-run Chinook salmon spawn primarily in the mainstem Sacramento River between Keswick Dam (RM 302) and the Red Bluff Diversion Dam (RBDD) (RM 242). Winter-run Chinook salmon spawn between late April and mid-August, with peak spawning generally occurring in June (Snider et al. 2000) (Table 11-5).

Juvenile emigration (downstream migration) past the RBDD (RM 242) begins in late July, peaks during September, and may extend through mid-March (National Marine Fisheries Service 1997). The peak period of juvenile emigration through the lower Sacramento River into the Delta generally occurs between January and April (National Marine Fisheries Service 1997) (Table 11-5). Differences in peak emigration periods between these two locations suggest that juvenile winter-run Chinook salmon may exhibit a sustained residence in the upper or middle reaches of the Sacramento River before entering the lower Sacramento River and the Delta. Although the location and extent of rearing in these lower or middle reaches is unknown, it is believed that the duration of fry presence in an area is directly related to the magnitude of river flows during the rearing period (Stevens 1989).

Historical winter-run population estimates were as high as 230,000 adults in 1969, but declined to under 200 fish in the 1990s (Good et al. 2005). A rapid decline occurred from 1969 to 1979 after completion of the RBDD. Over the next 20 years, the population eventually reached a low point of only 186 adults in 1994. At that point, winter-run was at a high risk of extinction (Lindley et al. 2007). If not for a very successful captive broodstock program, construction of a temperature control device (TCD) on Shasta Dam, having the RBDD gates up for much of the year, and restrictions in the ocean harvest, the population would have likely failed to exist in the wild (National Marine Fisheries Service 2009). In recent years, the carcass survey population estimates of winter-run included a high of 17,205 (Table 11-6) in 2006, followed by a precipitous decline in 2007 that continued in 2008, when less than 3,000 adult fish returned to the upper Sacramento River. The preliminary estimate of the winter-run in 2008 is 2,850 fish (California Department of Fish and Game 2009).

Table 11-5. Assumed Life Stage Timing and Distribution of Selected Species Potentially Affected by the Proposed Program

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Late Fall–Run Chinook Salmon													
Adult Migration	SF Bay to Upper Sac River and Tributaries												
Spawning	Upper Sacramento River and Tributaries												
Egg Incubation	Upper Sacramento River and Tributaries												
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries												
Smolt Outmigration	Sacramento River and tributaries, Delta												
Juvenile Movement and Rearing	Upper Sacramento River and Tributaries												
Fall-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River and Tributaries												
Spawning[a]	Upper Sacramento River and Tributaries												
Egg Incubation[a]	Upper Sacramento River and Tributaries												
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries												
Smolt Outmigration	Sacramento River and tributaries, Delta												
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay												
Spring-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River and Tributaries												
Spawning	Upper Sacramento River and Tributaries												
Egg Incubation	Upper Sacramento River and Tributaries												
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries												
Smolt Outmigration	Sacramento River and tributaries, Delta												
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay												

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Winter-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River												
Spawning	Upper Sacramento River												
Egg Incubation	Upper Sacramento River												
Juvenile Rearing (Natal Stream)	Upper Sacramento River to SF Bay												
Smolt Outmigration	Sacramento River and tributaries, Delta												
Juvenile Movement and Rearing	Upper Sacramento River to SF Bay												
Steelhead													
Adult Migration	SF Bay to Upper Sacramento River and Tributaries												
Spawning	Upper Sacramento River and Tributaries												
Egg Incubation	Upper Sacramento River and Tributaries												
Juvenile Rearing	Upper Sacramento River and Tributaries to SF Bay												
Smolt Outmigration	Sacramento River and tributaries, Delta												
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay												
Longfin Smelt													
Adult Migration	Suisun Bay												
Spawning	Downstream of Rio Vista on the Sacramento River[a]												
Juvenile Rearing	Suisun Marsh/Delta												
Juvenile Movement	Delta												
Sacramento Splittail													
Adult Migration	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Sacramento River and SJR												

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spawning	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Lower Sacramento and SJ Rivers												
Larval and Early Juvenile Rearing and Movement	Suisun Marsh, Upper Delta, Yolo Bypass, Sutter Bypass, Lower Sacramento and San Joaquin Rivers												
Adult and Juvenile Rearing	Delta, Suisun Bay												
Delta Smelt													
Adult Migration	Delta												
Spawning	Delta, Suisun Marsh												
Larval and Early Juvenile Rearing	Delta, Suisun Marsh												
Estuarine Rearing: Juveniles and Adults	Lower Delta, Suisun Bay												
Hardhead													
Adult Migration and Spawning	Sacramento River, San Joaquin River, Central Valley Reservoirs												
Adult, Larval and Juvenile Rearing	Sacramento and San Joaquin Rivers and Tributaries												
River Lamprey													
Adult Migration	Sacramento River, San Joaquin River, and tributaries												
Spawning	Sacramento River San Joaquin River, and tributaries												
Ammocoete Rearing	Sacramento River San Joaquin River, and tributaries												

Notes:

SF Bay = San Francisco Bay.

SJR = San Joaquin River.

[a] Spawning and incubation occurs from October to February in the Feather, American, and Mokelumne Rivers

Sources: Brown 1991; Wang and Brown 1993; U.S. Fish and Wildlife Service 1996; McEwan 2001; Moyle 2002; Hallock 1989; U.S. Army Corps of Engineers 2006.

Table 11-6. Winter-Run Chinook Salmon Population Estimates and Corresponding Cohort Replacement Rates since 1986

Year	Population Estimate[a]	5-Year Moving Average of Population Estimate
1986	2,596	–
1987	2,186	–
1988	2,885	–
1989	696	–
1990	433	1,759
1991	211	1,282
1992	1,240	1,092
1993	387	593
1994	186	491
1995	1,297	664
1996	1,337	889
1997	880	817
1998	3,002	1,340
1999	3,288	1,961
2000	1,352	1,972
2001	8,224	3,349
2002	7,441	4,661
2003	8,218	5,705
2004	7,701	6,587
2005	15,730	9,463
2006	17,205	11,259
2007	2,488	10,268
2008	2,850	9,195
median	2,488	1,961

[a] Population estimates were based on Red Bluff Diversion Dam counts until 2001. Starting in 2001, population estimates were based on carcass surveys.

Source: California Department of Fish and Game 2009.

Spring-Run

The Central Valley spring-run Chinook salmon ESU, which includes populations spawning in the Sacramento River and its tributaries, is listed as threatened under ESA and CESA. Critical habitat for spring-run Chinook salmon includes the Sacramento River, American River, Feather River, Bear River, Yuba River, and Cache and Miner Sloughs (70 Federal Register [FR] 52488, September 2, 2005).

Spring-run Chinook salmon historically occurred from the upper tributaries of the Sacramento River to the upper tributaries of the San Joaquin River. However, they have been extirpated from the San Joaquin River system. The only streams in the Central Valley with remaining wild spring-run Chinook salmon populations are the Sacramento River and its tributaries, including the Yuba River, Mill Creek, Deer Creek, and Butte Creek.

Spring-run Chinook salmon enter the Sacramento River from late March through September (Reynolds et al. 1993), but peak abundance of immigrating adults in the Delta and lower Sacramento River occurs from April through June (Table 11-5). Adult spring-run Chinook salmon remain in deep-water habitats downstream of spawning areas during summer until their eggs fully develop and become ready for spawning. This is the primary characteristic that distinguishes spring-run Chinook salmon from the other runs. Spring-run Chinook salmon spawn primarily upstream of the RBDD and in the aforementioned tributaries. Spawning occurs from mid-August through early October (Reynolds et al. 1993) (Table 11-5). A small portion of an annual year-class may emigrate as post-emergent fry (less than 1.8 inches long) and reside in the Delta undergoing smoltification. However, most are believed to rear in the upper river and tributaries during winter and spring, emigrating as juveniles (more than 1.8 inches long). The timing of juvenile emigration from the spawning and rearing reaches can vary depending on tributary of origin and can occur from November through June (Table 11-5).

On the Feather River, significant numbers of spring-run, as identified by run timing, return to the Feather River Hatchery (FRFH). From 1986 to 2007, the average number of spring-run returning to the FRFH was 3,992, compared with an average of 12,888 spring-run returning to the entire Sacramento River Basin (Table 11-7). Coded wire tag (CWT) information from these hatchery returns indicates substantial hybridization has occurred between spring-run and fall-run populations within the Feather River system because of hatchery practices. Because Chinook salmon have not always been temporally separated in the hatchery, spring-run and fall-run have been spawned together, thus compromising the genetic integrity of the spring-run and early fall–run stocks. The number of naturally spawning spring-run in the Feather River has been estimated only periodically since the 1960s, with estimates ranging from 2 fish in 1978 to 2,908 in 1964 (National Marine Fisheries Service 2009).

The spring-run ESU has displayed broad fluctuations in adult abundance, ranging from 1,403 in 1993 to 25,890 in 1982 (Table 11-7). Sacramento River tributary populations in Mill, Deer, and Butte Creeks are probably the best trend indicators for the spring-run ESU as a whole because these streams contain the primary independent populations within the ESU. Generally, these streams have shown a positive escapement trend since 1991. Escapement numbers are dominated by Butte Creek returns, which have averaged more than 7,000 fish since 1995. During this same period, adult returns on Deer Creek have averaged 1,463 fish. Although recent trends are positive, annual abundance estimates display a high level of fluctuation, and the overall number of spring-run remains well below estimates of historic abundance. In 2008, adult escapement of spring-run declined in several of the region’s watersheds. Deer Creek had an estimated 140 fish return to the watershed. These fluctuations may be attributable to poor ocean conditions that existed when the returning 2008 adults entered the ocean as smolts (spring of 2006) and led to poor ocean survival in the critical ocean entry phase of their life history. Additional factors that have limited adult spawning populations are in-river water quality conditions (National Marine Fisheries Service 2009).

Fall- and Late Fall–Run

Central Valley fall-run and late fall–run Chinook salmon are commercially and recreationally important. These ESUs are federal species of concern. Because the fall-run Chinook salmon is currently the largest run of Chinook salmon in the Sacramento River system, it continues to support commercial and recreational fisheries of significant economic importance.

Table 11-7. Central Valley Spring-Run Chinook Salmon Population Estimates with Corresponding Cohort Replacement Rates since 1986

Year	Sacramento River Basin Escapement Run Size[a]	FRFH Population	Tributary Populations
1986	25,696	1,433	24,263
1987	13,888	1,213	12,675
1988	18,933	6,833	12,100
1989	12,163	5,078	7,085
1990	7,683	1,893	5,790
1991	5,927	4,303	1,624
1992	3,044	1,497	1,547
1993	6,075	4,672	1,403
1994	6,187	3,641	2,546
1995	15,238	5,414	9,824
1996	9,082	6,381	2,701
1997	5,086	3,653	1,433
1998	31,471	6,746	24,725
1999	9,835	3,731	6,104
2000	9,234	3,657	5,577
2001	17,698	4,135	13,563
2002	17,409	4,189	13,220
2003	17,570	8,662	8,908
2004	13,986	4,212	9,774
2005	16,117	1,771	14,346
2006	10,652	1,952	8,700
2007	10,571	2,752	7,819
Median	10,652	3,731	7,819

[a] National Marine Fisheries Service included both the escapement numbers from the Feather River Fish Hatchery (FRFH) and the Sacramento River and its tributaries in this table. Sacramento River Basin run size is the sum of the escapement numbers from the FRFH and the tributaries.

Source: California Department of Fish and Game 2009.

All Central Valley streams that had adequate flows in the fall, even if they were intermittent during the summer, probably supported fall-run Chinook salmon. Unlike spring- and winter-run Chinook salmon that migrated to higher elevation streams, fall-run Chinook salmon likely were limited to streams of the valley floor and lower foothill reaches because of their egg-laden and generally deteriorated physical condition.

In general, adult fall-run Chinook salmon migrate into the Sacramento River and its tributaries from July through December, with immigration peaking from mid-October through November (Table 11-5). Fall-run Chinook salmon spawn in numerous tributaries of the Sacramento River, including the lower American River, lower Yuba River, Feather River, and tributaries of the upper Sacramento River. Most mainstem Sacramento River spawning occurs between Keswick Dam and the RBDD. A greater extent of fall-run spawning, relative to the other three runs, occurs below the RBDD, with limited spawning potentially occurring as far downstream as Tehama (RM 220) (Yoshiyama et al. 1996). Spawning generally occurs from October through December, with fry emergence typically beginning in late December and January (Table 11-5). Fall-run Chinook salmon emigrate as post-emergent fry, juveniles, and smolts after rearing in their natal streams for up to 6 months. Consequently, fall-run emigrants may be present in the lower Sacramento River from January through June (Reynolds et al. 1993) (Table 11-5) and remain in the Delta for variable lengths of time before ocean entry.

Adult immigration of late fall–run Chinook salmon into the Sacramento River generally begins in October, peaks in December, and ends in April (Moyle et al. 1995) (Table 11-5). Primary spawning areas for late fall–run Chinook salmon are located in tributaries of the upper Sacramento River (e.g., Battle Creek, Cottonwood Creek, Clear Creek, Mill Creek), although late fall–run Chinook salmon are believed to return to the Feather and Yuba Rivers as well (Moyle et al. 1995). Spawning in the mainstem Sacramento River occurs primarily from Keswick Dam to the RBDD, generally from January through April (Moyle et al. 1995). Juveniles emigrate through the lower Sacramento River primarily from October through April (Table 11-5).

After 2–5 years in the ocean, adult Chinook salmon leave the ocean and migrate upstream to the Sacramento River and its tributaries to spawn. Chinook salmon take advantage of the diversity and variability of river systems through variable life history adaptations (Moyle 2002). The names of the Chinook salmon runs (i.e., fall, late fall, spring, and winter) reflect the variability in life history timing of the adult fish. Spawning occurs in cool reaches of Central Valley rivers that, with few exceptions, are just downstream of the terminal dams. Adult salmonids either spawn soon after entering fresh water, as in the case of fall-run Chinook salmon, or spend time in fresh water before reaching maturity, like spring and winter-run Chinook salmon. Chinook salmon deposit their eggs in gravel nests, called redds, located on riffles, runs, and pool tails. Eggs generally hatch in 6–9 weeks, and yolk-sac larvae remain in the gravel for several more weeks. After emergence, juvenile Chinook salmon may rear along the channel edge or begin their movement downstream. Juvenile Chinook salmon may remain in fresh water for 3 to 14 months or even longer.

Fall-run Chinook salmon adults and juveniles occur in all of the program reaches, although smaller numbers occur in Elder Creek and Bear River which depend on flows. Juveniles of all runs may occur in the Delta sloughs as they migrate downstream to the Pacific Ocean.

The total number of natural fall-run Chinook salmon counted from the Feather, Yuba and American rivers was 13,075 in 2008. The total including the upper Sacramento River was 51,504 fish in 2008. The high in 2002 was a total of 720,782 fish including the Feather, Yuba, American and Sacramento Rivers. The year 2008 had the lowest recorded number of fall-run Chinook returns on record (Pacific Fishery Management Council 2009).

Steelhead

The Central Valley steelhead distinct population segment (DPS) is listed under the ESA as threatened (63 FR 13347, March 19, 1998). Critical habitat for Central Valley steelhead includes the Sacramento River, Elder Creek, Deer Creek, American River, Feather River, Bear River, Yuba River, and Cache and Miner Sloughs (70 FR 52448, September 2, 2005).

Steelhead have one of the most complex life histories of any salmonid species. Steelhead are anadromous, but some individuals may never leave fresh water—hatching, rearing, and spawning within a given river reach. Freshwater residents typically are referred to as rainbow trout, while anadromous individuals are called steelhead (National Marine Fisheries Service 1996a).

Adult Central Valley steelhead migrate upstream from the ocean during July through March in the Sacramento River; most adults enter the freshwater system in September and October (Table 11-5) (Busby et al. 1996; Hallock 1989). Spawning in the program area peaks in January and February and can occur from December through May. Individual steelhead may spawn more than once, returning to the ocean between each spawning migration. Steelhead spawn in relatively clean, cool (less than 57°F) water and build their redds and lay their eggs in clean gravel at the heads of riffles. The eggs hatch between 19 days and 80 days after spawning, depending on water temperature. Larvae remain in the gravel for several weeks before emerging as fry (National Marine Fisheries Service 1996a).

Juvenile Central Valley steelhead typically rear 1 or 2 years in fresh water before migrating to the ocean. Juvenile (smolt-sized fish greater than 4 inches) steelhead migrate to the ocean from December through August (Table 11-5). The peak months of juvenile migration are January to May (McEwan 2001). After 1–2 years of ocean residence, adult steelhead return to their natal stream to spawn as 3- or 4-year-olds (Hallock et al. 1961).

Central Valley steelhead occur in the program area, either as adults migrating upstream to their spawning habitat, or as juveniles rearing and migrating toward the ocean. Juvenile steelhead tend to use bank habitat more frequently than the main channel, because bank habitat provides increased protection, shade, and food.

Over the past 30 years, the naturally spawned steelhead populations in the upper Sacramento River have declined substantially. Hallock et al. (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River, upstream of the Feather River. Steelhead counts at the RBDD declined from an average of approximately 8,000 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento–San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996; McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 because of changes in dam operations.

Wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks and the Yuba River. Populations may exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996). There is still a nearly complete lack of steelhead monitoring in the Central Valley (Good et al. 2005); therefore, data are lacking regarding a definitive population size for Central Valley steelhead. However, the little data that exist indicate that the population continues to decline (Good et al. 2005).

Delta Smelt

The delta smelt is listed under both the ESA and CESA as a threatened species (58 FR 12854, March 5, 1993). The designated critical habitat for delta smelt encompasses the Delta and the Sacramento River upstream to the mouth of American River (RM 60).

Rearing habitat for juvenile and adult delta smelt typically is found in the estuarine waters of the lower Delta and Suisun Bay where salinity is between 2 and 7 parts per thousand (ppt), although delta smelt tolerate 0 ppt to 19 ppt salinity. They typically occupy open shallow waters but also occur in the main channel in the region where fresh water and brackish water mix. The zone may be hydraulically conducive to their ability to maintain position and metabolic efficiency (Moyle 2002).

Adult delta smelt begin a spawning migration, which may encompass several months, and move into the upper Delta during December or January (Table 11-5). Spawning occurs between January and July, with peak spawning during April through mid-May (Moyle 2002). Spawning occurs in shallow edgewaters in the upper Delta channels, including the Sacramento River above Rio Vista, Cache Slough, Lindsey Slough, and Barker Slough. Spawning also was observed in the Sacramento River up to Garcia Bend during drought conditions, possibly attributable to adults moving farther inland in response to saltwater intrusion (Wang and Brown 1993). Eggs are broadcast over the bottom, where they may attach to firm sediment, woody material, and vegetation; however, spawning in the wild has not been observed and so the actual substrates used are not known. Hatching takes approximately 9 to 13 days, and larvae begin feeding 4 to 5 days later. Newly hatched larvae contain a large oil globule that makes them semi-buoyant and allows them to stay off the bottom. Larval smelt feed on rotifers and other zooplankton. As their fins and swim bladder develop, they move higher into the water column. Larvae and juveniles gradually move downstream toward rearing habitat in the estuarine mixing zone (Wang 1986). A portion of the delta smelt population may reside in the Cache Slough complex throughout the year and may not undergo the annual migration typical of the species (Sommer et al. 2009).

Delta smelt occur in the lower Sacramento River, downstream of the confluence with the American River, and in the Delta sloughs. Delta smelt critical habitat is designated in the Sacramento River downstream of the American River and in the Delta. Adults may occur into the Sacramento River during the winter and early spring and most spawning appears to occur downstream in tidally influenced backwater sloughs and channel edgewaters of the upper Delta, including the Sacramento River above Rio Vista, Cache Slough, Lindsey Slough, and Barker Slough.

The Fall Midwater Trawl (FMWT) provides the best available long-term index of the relative abundance of delta smelt (Moyle et al. 1992; Sweetnam 1999). The indices derived from these surveys closely mirror trends in catch per unit effort (Kimmerer and Nobriga 2005), but do not at present support statistically reliable population abundance estimates, though substantial progress has recently been made (Newman 2008). FMWT derived data are generally accepted as providing a reasonable basis for detecting and roughly scaling interannual trends in delta smelt abundance.

The FMWT derived indices have ranged from a low of 27 in 2005 to 1,653 in 1970. For comparison, Townet Survey (TNS) derived indices have ranged from a low of 0.3 in 2005 to a high of 62.5 in 1978. Although the peak high and low values have occurred in different year, the TNS and FMWT indices show a similar pattern of delta smelt relative abundance; higher prior to the mid-1980s and very low in the past seven years (U.S. Fish and Wildlife Service 2008).

From 1969–1981, the mean delta smelt TNS and FMWT indices were 22.5 and 894, respectively. Both indices suggest the delta smelt population declined abruptly in the early 1980s (Moyle et al. 1992). From 1982–1992, the mean delta smelt TNS and FMWT indices dropped to 3.2 and 272 respectively. The population rebounded somewhat in the mid-1990s (Sweetnam 1999); the mean TNS and FMWT indices were 7.1 and 529, respectively, during the 1993–2002 period. However, delta smelt numbers have trended precipitously downward since about 2000 (U.S. Fish and Wildlife Service 2008).

Currently, the delta smelt population indices are two orders of magnitude smaller than historical highs and recent population abundance estimates are up to three orders of magnitude below historical highs (Newman 2008). After 1999 both the FMWT and the TNS population indices showed declines, and from 2000 through 2007 the median FMWT index was 106.5. The lowest FMWT abundance indices ever obtained were recorded during 2004–2007 (74, 27, 41, and 28, respectively) (U.S. Fish and Wildlife Service 2008).

The median TNS index during the period from 2000 through 2008 fell similarly to 1.6, and has also dropped to its lowest levels during the last four years with indexes of 0.3, 0.4, 0.4, and 0.6 during 2005 through 2008, respectively. It is highly unlikely that the indices from 2004–2007 can be considered statistically different from one another (Sommer et al. 2007), but they are very likely lower than at any time prior in the period of record. The total number of delta smelt collected in the 20-millimeter Survey decreased substantially during the years from 2002 to 2008 (4,917 to 587 fish) compared to the period 1995 through 2001 (98 to 1,084 fish) (U.S. Fish and Wildlife Service 2008).

Green Sturgeon

The southern DPS of North American green sturgeon (*Acipenser medirostris*) currently is listed as threatened under the federal ESA and is a California species of special concern (Moyle et al. 1995). The southern DPS boundary currently includes all populations of green sturgeon south of the Eel River, with the only known population being in the Sacramento River (Adams et al. 2002). Critical habitat for green sturgeon has not yet been defined.

Green sturgeon are the most widely distributed sturgeon species, known to range from nearshore waters of Mexico to the Bering Sea (Adams et al. 2002: 1). Despite this large geographic range, the only known spawning locations for green sturgeon are in the Klamath, Sacramento, and Rogue Rivers (Adams et al. 2002: 1). In the southern DPS, adults and juveniles occur in the upper Sacramento River, where the majority of spawning occurs. Incidental capture of larval green sturgeon in salmon outmigrant traps indicates that the lower Feather River may be a principal spawning area, but spawning there has never been substantiated (Adams et al. 2002: 5). Juveniles are captured annually at trapping facilities at the RBDD and the Glenn-Colusa Irrigation District (GCID) diversion on the Sacramento River (Adams et al. 2002: 5). Adams et al. (2002) found no evidence that green sturgeon currently spawn in the San Joaquin River. Young green sturgeon have been taken at Santa Clara Shoal, Brannan Island State Recreational Area, but these fish may have originated from another location (Adams et al. 2002).

Green sturgeon are the most marine species of sturgeon, making extensive oceanic migrations and only coming into freshwater rivers to spawn. Adults migrate into rivers to spawn from April to July, with May to June being the peak season. Green sturgeon first reach sexual maturity at age 15 for males and 17 for females, with spawning thought to occur every 3 to 5 years (Tracy 1990 in Adams et al. 2002). Preferred spawning substrate likely is large cobble but can range from clean sand to bedrock (Moyle 1992 in Adams et al. 2002: 8). Eggs are broadcast and externally fertilized in relatively fast water and probably in depths of more than 3 meters (about 10 feet). Specific water quality requirements are unknown, but a small amount of silt is known to prevent the eggs from adhering to each other, thus increasing survival (Moyle 2002, 111).

Young green sturgeon grow rapidly, reaching 74 millimeter (mm) (about 3 inches) 45 days post-hatching. Based on trapping data from the RBDD and the GCID trap (downstream of RBDD), juvenile green sturgeon average 29 mm in length during June and July at RBDD and 36 mm in July at GCID (Adams et al. 2002: 9). Juvenile sturgeon may spend between 1 and 3 years in fresh water before migrating to the ocean (Adams et al. 2002: 9) but may spend time near estuaries at first to rear (Moyle 2002: 111). Juvenile green sturgeon have been collected in the Sacramento River, near Hamilton City, and in the Delta and San Francisco Bay. According to Kohlhorst et al. (1991), juveniles inhabit the estuary until they are approximately 4 to 6 years old, when they migrate to the ocean.

Adult and juvenile sturgeon are benthic (bottom) feeders, but may also take small fish. Juveniles in the Sacramento–San Joaquin Estuary feed primarily on opossum shrimp and amphipods (Moyle 2002: 110).

Green sturgeon adults occur in the program area when migrating to and from upstream spawning habitat. Juveniles occur in the program area during downstream migration. Juveniles also may rear in the area. The general behavior and distribution patterns indicate that the earliest life stages (larvae and post-larvae) rear upstream of the program area for several months before migrating to the Delta and estuary. Salvage and trawling records from the Delta suggest that most juveniles in the program area are likely to be more than 200 millimeters long and at least 9 months old. Juveniles move downstream in the Sacramento River from May to August (Beamesderfer et al. 2006) (Table 11-5).

Population abundance information concerning the Southern DPS of green sturgeon is described in the NMFS status reviews (Adams et al. 2002; National Marine Fisheries Service 2005). Limited population abundance information comes from incidental captures of North American green sturgeon from the white sturgeon monitoring program by the California Department of Fish and Wildlife (DFW) sturgeon tagging program (California Department of Fish and Game 2002). By comparing ratios of white sturgeon with green sturgeon captures, DFW provides estimates of adult and sub-adult North American green sturgeon abundance. Estimated abundance between 1954 and 2001 ranged from 175 fish in 1993 to more than 8,421 in 2001, and averaged 1,509 fish per year. Unfortunately, there are many biases and errors associated with these data, and DFW does not consider these estimates reliable because the population estimates are based on small sample sizes, intermittent reporting, and inferences made from white sturgeon catches. Fish monitoring efforts at RBDD and GCID on the upper Sacramento River have captured between 0 and 2,068 juvenile Southern DPS of green sturgeon per year (Adams et al. 2002).

Longfin Smelt

DFW has designated longfin smelt as a state threatened species (June 26, 2009). Historically, longfin smelt populations were found in the Klamath, Eel, and San Francisco estuaries, and in Humboldt Bay. From recent sampling, populations reside at the mouth of the Klamath River and the Russian River estuary. In the Central Valley, longfin are rarely found upstream of Rio Vista or Medford Island in the Delta. Adults concentrate in Suisun, San Pablo, and North San Francisco Bays (Moyle 2002).

Longfin smelt are anadromous, euryhaline, and nektonic (free-swimming). Adults and juveniles are found in estuaries and can tolerate salinities from 0 parts per thousand (ppt) to pure seawater. The salinity tolerance of longfin smelt larvae and early juveniles ranges from 1.1 to 18.5 ppt. After the early juvenile stage, they prefer salinities in the 15–30 ppt range (Moyle 2002). Longfin smelt in the San Francisco estuary spawn in fresh or slightly brackish water (Moyle 2002: 236). Prior to spawning, these fish aggregate in deepwater habitats available in the northern Delta, including primarily the channel habitats of Suisun Bay and the Sacramento River (Rosenfield and Baxter 2007). Catches of gravid adults and larval longfin smelt indicate that the primary spawning locations for these fish are in or near the Suisun Bay channel, the Sacramento River channel near Rio Vista, and (at least historically) Suisun Marsh (Wang 1991; Moyle 2002; Rosenfield and Baxter 2007). Moyle (2002) indicated that longfin smelt may spawn in the San Joaquin River as far upstream as Medford Island. Two sampling programs operated by DFW during the spawning season—the Fall Mid-Water Trawl and the Bay Study—found most of the juveniles were caught in the lower Sacramento River and Suisun Bay. In the Delta, longfin smelt spend most of their life cycle in deep, cold, brackish-to-marine waters of the Delta and nearshore environments (Moyle 2002; Rosenfield and Baxter 2007). They are capable of living their entire life cycle in fresh water, as demonstrated by landlocked populations.

Prespawning adults are generally restricted to brackish (2–35 ppt salinity) or marine habitats. In the fall and winter, yearlings move upstream into fresh water to spawn. Spawning may occur as early as November, and larval surveys indicate it may extend into June (Moyle 2002). The exact nature and extent of spawning habitat are still unknown for this species (Moyle 2002), although major aggregations of gravid adults occur in the northwestern Delta and eastern Suisun Bay (Rosenfield and Baxter 2007).

Embryos hatch in 40 days at 7°C and are buoyant. They move into the upper part of the water column and are carried into the estuary. High outflows transport the larvae into Suisun and San Pablo Bays. In low outflow years, larvae move into the western Delta and Suisun Bay. Higher outflows are reflected positively in juvenile survival and adult abundance. Rearing habitat is highly suitable in Suisun and San Pablo Bays in part because juveniles require brackish water in the 2–18 ppt salinity range. Longfin smelt are pelagic foragers that feed extensively on copepods, amphipods, and shrimp (U.S. Fish and Wildlife Service 1996; Moyle 2002). Severe alterations in the composition and abundance of the primary producer and primary/secondary consumer assemblages in the Delta have been implicated in the recent decline of longfin smelt and other native fish species (U.S. Fish and Wildlife Service 1996; Kimmerer 2002).

The abundance of longfin smelt in the San Francisco Estuary has fluctuated over time. However, abundance has been in decline since the early 1980's and was very low during the drought years of the 1990's and recent wet years (Rosenfield and Baxter 2007; Sommer et al. 2007). The decline has been seen in the reduction of longfin smelt captured in the percent of trawls throughout the Bay (Rosenfield and Baxter 2007). The 2007 FMWT had the lowest index (13) recorded since the survey began in 1967. The highest index between 1988 and 2008 was 8,205 in 1995. The index in 2008 was 139 (California Department of Fish and Game 2008).

Sacramento Splittail

The Sacramento splittail was previously listed under the ESA as a threatened species; however, in 2003, the U.S. Fish and Wildlife Service (USFWS) remanded the listing of the species, removing its special status. The splittail is identified as a species of special concern by DFW.

Adult splittail migrate from Suisun Bay and the Delta to upstream spawning habitat during December through April (Table 11-5). Surveys conducted by the DFW and the DWR in 1995 indicate that the Yolo and Sutter Bypasses provide important spawning habitat (Sommer et al. 1997). Adult splittail deposit adhesive eggs over flooded terrestrial or aquatic vegetation when water temperature is between 9°C and 20°C (Moyle 2002; Wang 1986). Splittail spawn in late April and May in Suisun Marsh and between early March and May in the upper Delta and lower reaches and flood bypasses of the Sacramento and San Joaquin Rivers (Moyle et al. 1995). Spawning has been observed to occur as early as January and may continue through early July (Table 11-5) (Wang 1986; Moyle 2002).

Larval splittail are commonly found in shallow, vegetated areas near spawning habitat. Larvae eventually move into deeper and more open-water habitat as they grow and become juveniles. During late winter and spring, young-of-year juvenile splittail (i.e., production from spawning in the current year) are found in sloughs, rivers, and Delta channels near spawning habitat (Table 11-5). Juvenile splittail gradually move from shallow, nearshore areas to deeper, open-water habitat of Suisun and San Pablo Bays (Wang 1986). In areas upstream of the Delta, juvenile splittail can be expected to be present in the flood bypasses when these areas are inundated during the winter and spring (Jones & Stokes Associates 1993; Sommer et al. 1997).

Sacramento splittail were captured in the annual Yolo Bypass surveys. Adult splittail were captured at the highest rate since the project started 10 years ago, although juvenile numbers were low. Small numbers of juveniles may be attributable to dry winter conditions of 2008 (Reece and Sommer 2008).

Hardhead

Hardhead are a special-status species that are not listed as threatened or endangered under the federal ESA or CESA, but are listed in California as a species of special concern. Hardhead are widely distributed in low- to mid-elevation streams in the Sacramento River and San Joaquin River Basins. In the San Joaquin River Basin, the species is scattered in tributary streams. The species is absent from valley reaches of the Lower San Joaquin River. Hardhead are also abundant in a few mid-elevation reservoirs used largely for hydroelectric power generation, such as Redinger and Kerkhoff Reservoirs in the SJR basin (Moyle 2002).

Most streams in which they occur have summer temperatures in excess of 68°F, and optimal temperatures for hardhead are determined to be 75°F to 83°F. At higher temperatures hardhead are relatively intolerant of low oxygen levels, a factor that may limit their distribution to well-oxygenated streams and to surface water of reservoirs. They prefer clear, deep (>80 cm) pools and runs with sand-gravel-boulder substrates and slow velocities (20 to 40 cm/sec). Hardhead are always found in association with Sacramento pikeminnow and usually with Sacramento sucker, and tend to be absent from streams where introduced species, especially centrarchids, predominate.

Hardhead are omnivores that consume drifting insects and algae in the water column, and forage for benthic invertebrates and aquatic plant material on the bottom of the river floor (Alley and Li 1977).

Hardhead mature in their third year and spawn mainly in April and May (Grant and Maslin 1999). Juvenile recruitment patterns suggest that spawning may extend into August in some foothill streams. Fish from larger rivers or reservoirs may migrate 30 to 75 kilometers or more upstream in April and May, usually into tributary streams (Moyle et al. 1995). In small streams hardhead may move only a short distance from their home pools for spawning, either upstream or downstream (Grant and Maslin 1999).

River Lamprey

River lamprey is currently designated by DFW as a species of special concern (California Department of Fish and Game 2012). Although river lamprey is widely believed to be in decline, the exact status of this species is uncertain. Currently, very little information describing the abundance and distribution of river lamprey is available, perhaps because the species is often overlooked and seldom studied. River lamprey is thought to occur throughout Pacific coast streams. In California, its distribution includes tributaries of San Francisco Bay, such as the Napa River, Sonoma Creek, Alameda Creek, Sacramento River, San Joaquin River, and Russian River (Moyle et al. 1995; Moyle 2002).

Limited information is available regarding the life history of this species in California. Current accounts are based largely on information from Canadian populations (Moyle 2002). River lamprey is a semelparous (i.e., individuals spawn once, then die) anadromous fish with long freshwater rearing periods. Adults return to fresh water to spawn in fall and winter, with spawning usually occurring from February through March in gravely riffles in small tributary streams (Moyle 2002). Juvenile river lamprey (ammocoetes) remain in silty backwater habitats, where they filter feed on various microorganisms for approximately 3–5 years before migrating to the ocean during late spring periods (Moyle et al. 1995, Moyle 2002). Adult lamprey prey on other fish and may reach a total length of around 7 inches (Moyle et al. 1995).

Commercially Important Fish

Striped bass, American shad, and largemouth bass are all sport fish species and were introduced into rivers for that purpose. Striped bass and largemouth bass are regulated by DFW for recreational fishing. Threadfin shad are nonnative fish species that were introduced as forage fish for game fish. Striped bass are not recognized as spawning or rearing in the Sacramento River and American shad reportedly migrate upstream. Sportfishing for striped bass, American shad, Chinook salmon, steelhead, sturgeon, and warmwater fish occurs seasonally throughout the lower Sacramento River.

Factors Affecting Abundance of Central Valley Fishes

Information relating species abundance to environmental conditions is most available for listed fish species and species of concern, especially Chinook salmon. This section focuses on factors that have contributed to declines in these species or identified as major factors currently affecting the abundance of listed fish species in the Central Valley. Although not specifically referenced, many of the factors discussed for listed fish species also have affected the abundance of other native and nonnative species.

Spawning Habitat

The amount of spawning habitat may limit the production of juveniles and subsequent adult abundance of some species. Spawning habitat area for fall- and late fall–run Chinook salmon, which make up more than 90% of the Chinook salmon returning to the Central Valley streams, has been identified as limiting their population abundance. Spawning habitat area has not been identified as a limiting factor for the less abundant winter-run and spring-run Chinook salmon (National Marine Fisheries Service 1996b; U.S. Fish and Wildlife Service 1996), although spawning habitat may be limiting in some streams during years of high adult abundance (e.g., Butte Creek).

The effect of spawning habitat availability as a limiting factor has not been determined for longfin smelt, steelhead or green sturgeon.

Delta smelt spawn in fresh water at low tide on aquatic plants, submerged and inshore plants, and over sandy and hard bottom substrates of sloughs and shallow edges of channels in the upper Delta and Sacramento River above Rio Vista (Wang 1986; Moyle 2002). The amount of spawning habitat has not been identified as a limiting factor for delta smelt.

A lack of sufficient seasonally flooded vegetation may limit splittail spawning during dry years (Young and Cech 1996). Splittail spawn over flooded vegetation and debris mostly, on floodplains that are inundated by high flow from February to early July in the Sacramento River and San Joaquin River. The onset of spawning appears to be associated with rising water levels, increasing water temperature and day length (Moyle 2002). The Sutter and Yolo Bypasses along the Sacramento River are important spawning habitat areas during high flow.

Rearing Habitat

The amount of rearing habitat may limit the production of juveniles and subsequent adult abundance of some species. USFWS (1996) has indicated that rearing habitat area limits the abundance of juvenile fall-run and late fall–run Chinook salmon and juvenile steelhead. Rearing habitat for salmonids is defined by environmental conditions such as water temperature, dissolved oxygen, turbidity, substrate, water velocity, water depth, and cover (Jackson 1992; Bjornn and Reiser 1991; Healey 1991).

Environmental conditions and interactions among individuals, predators, competitors, and food sources determine habitat quantity and quality and the productivity of the stream (Bjornn and Reiser 1991). Everest and Chapman (1972) found juvenile Chinook salmon and steelhead of the same size using similar in-channel rearing area.

Rearing area varies with flow. High flow increases the area available to juvenile Chinook salmon because they extensively use submerged terrestrial vegetation on the channel edge and the floodplain. Deeper inundation provides more overhead cover and protection from avian and terrestrial predators than shallow water (Everest and Chapman 1972).

Rearing habitat has not been cited as a limiting factor in green sturgeon population abundance. It is unknown what specific habitat juvenile green sturgeon use as they migrate from the upper Sacramento River down into San Pablo Bay.

Rearing habitat for delta smelt encompasses the lower reaches of the Sacramento River below Isleton, the San Joaquin River below Mossdale, throughout the Delta, and into Suisun Bay. USFWS (1996) has indicated that loss of rearing habitat area would adversely affect the abundance of larval and juvenile delta smelt. The area and quality of estuarine rearing habitat is assumed to be dependent on the downstream location of approximately 2-ppt salinity (Moyle et al. 1992). Where 2-ppt salinity is located in the Delta is assumed to provide less and lower-quality habitat than 2-ppt salinity farther downstream in Suisun Bay. During years of average and high outflow delta smelt may concentrate anywhere from the Sacramento River around Decker Island to Suisun Bay (Moyle 2002).

Rearing habitat has not been cited as a limiting factor in Sacramento splittail population abundance, but, as with spawning, a lack of sufficient seasonally flooded vegetation may be limiting population abundance and distribution (Young and Cech 1996). Rearing habitat for splittail encompasses the Delta, Suisun Bay, Suisun Marsh, the lower Napa River, the lower Petaluma River, and other parts of San Francisco Bay (Moyle 2002). In Suisun Marsh, splittail concentrate in the dead-end sloughs that have small streams feeding into them (Daniels and Moyle 1983; Moyle et al. 1986 in Moyle 2002). As splittail grow, salinity tolerance increases (Young and Cech 1996). Salinity is not a limiting factor as splittail is able to tolerate salinity concentrations as high as 29 ppt (Moyle 2002).

Migration Habitat

The Sacramento River provides a migration pathway between freshwater and ocean habitats for adult and juvenile steelhead, all runs of Chinook salmon, and green sturgeon. Migration habitat conditions include stream flows that provide suitable water velocities and depths that provide successful passage. Flows in the Sacramento River provide the necessary depth, velocity, and suitable water temperature.

Larval and early juvenile delta smelt and longfin smelt are transported by currents that flow downstream into the upper end of the mixing zone of estuary where incoming saltwater mixes with outflowing fresh water (Moyle et al. 1992). Reduced flow may adversely affect transport of larvae and juveniles to rearing habitat.

Adult splittail gradually move upstream during the winter and spring months to spawn. Year class success of splittail is positively correlated with wet years, high Delta outflow, and floodplain inundation (Sommer et al. 1997; Moyle 2002). Low flow impedes access to floodplain areas to spawn.

Water Temperature

Fish species have different responses to water temperature conditions depending upon their physiological adaptations. Salmonids in general, have evolved under conditions where water temperatures are fairly cool. Green sturgeon also prefer cool water temperatures.

Delta smelt, longfin smelt and splittail can tolerate warmer temperatures. In addition to species-specific thresholds, different life stages have different water temperature requirements. Eggs and larval fish are the most sensitive to warm water temperature.

Unsuitable water temperatures for adult salmonids during upstream migration lead to delayed migration and potentially lower reproduction. Juvenile salmonid survival, growth, and vulnerability to disease are affected by water temperature. In addition, water temperature affects prey species abundance and predator occurrence and activity. Juvenile salmonids alter their behavior depending on water temperature, including movement to take advantage of local water temperature refugia (e.g., movement into stratified pools, shaded habitat, and subsurface flow) and to improve feeding efficiency (e.g., movement into riffles).

Water temperature in Central Valley rivers frequently exceeds the tolerance of Chinook salmon and steelhead life stages. Based on a literature review, it is assumed that conditions supporting adult Chinook salmon migration deteriorate as temperature warms between 53.6°F and 69.8°F (12°C to 21°C) (Hallock 1970 in McCullough 1999). For juvenile Chinook salmon, survival is assumed to decline as temperature warms from 64.4°F to 75.2°F (18°C and 24°C) (Myrick and Cech 2001; Rich 1987). Relative to rearing, Chinook salmon require cooler temperatures to complete the parr-smolt transformation and to maximize their saltwater survival. Successful smolt transformation is assumed to deteriorate at temperatures ranging from 62.6°F to 73.4°F (17°C to 23°C) (Marine 1997 in Myrick and Cech 2001; Baker et al. 1995).

For steelhead, successful adult migration and holding are assumed to deteriorate as water temperature warms between 52°F and 69.8°F (14°C to 21°C). Adult steelhead appear to be much more sensitive to thermal extremes than are juveniles (National Marine Fisheries Service 2009; McCullough 1999). Juvenile rearing success is assumed to deteriorate at water temperatures ranging from 62.6°F to 77°F (17°C to 25°C) (Raleigh et al. 1984; Myrick and Cech 2001). Relative to rearing, smolt transformation requires cooler temperatures, and successful transformation occurs at temperatures ranging from 42.8°F to 50°F (6°C to 10°C). Juvenile steelhead have been captured at Chipps Island in June and July and at water temperatures exceeding 68°F (20°C) (Nobriega and Cadrett 2001). Juvenile Chinook salmon also have been observed to migrate at water temperatures warmer than expected based on laboratory experimental results (Baker et al. 1995).

> Green sturgeon prefer cool water temperatures for spawning, embryonic development, and rearing. Spawning typically occurs when water temperatures are 46 to 57°F, and embryonic development is optimal when water temperatures are 52 to 66°F. Temperatures above 68°F are lethal for embryos (Cech et al. 2004), and overwintering juveniles stop migrating downstream when temperatures reach 46°F or below (Kynard et al. 2005).

Delta smelt and splittail populations are adapted to water temperature conditions in the Delta. Delta smelt may spawn at temperatures as high as 22°C (U.S. Fish and Wildlife Service 1996) and can rear and migrate at temperatures as warm as 28°C (Swanson and Cech 1995). Splittail may withstand temperatures as warm as 33°C and prefer a temperature range between 19°C and 24°C (Young and Cech 1996). Longfin smelt prefer summer water temperatures between 16–18°C, but can tolerate temperatures up to 20°C (Moyle 2002, 236).

Contaminants

In the Sacramento River and San Joaquin River Basins, industrial and municipal discharge and agricultural runoff introduce contaminants into rivers and streams that ultimately flow into the Delta. Organophosphate insecticides, such as carbofuran, chlorpyrifos, and diazinon, are present throughout the Central Valley and are dispersed in agricultural and urban runoff. These contaminants enter rivers in winter runoff and enter the estuary in concentrations that can be toxic to invertebrates (CALFED Bay-Delta Program 2000). Because they accumulate in living organisms, these contaminants may become toxic to fish species, especially those life stages that remain in the system year-round and spend considerable time during the early stages of development, such as Chinook salmon, steelhead, green sturgeon, splittail, and delta smelt.

Predation

Nonnative species cause substantial predation mortality on native species. Studies at Clifton Court Forebay estimated predator-related mortality of hatchery-reared fall-run Chinook salmon from about 60% to more than 95%. Although the predation contribution to mortality is uncertain, the estimated mortality suggests that striped bass and other predatory fish, primarily nonnative, pose a threat to juvenile Chinook salmon moving downstream, especially where the stream channel has been altered from natural conditions (California Department of Water Resources 1995). Predators such as striped bass, largemouth bass, and catfish also prey on delta smelt, splittail (U.S. Fish and Wildlife Service 1996) and possibly longfin smelt. The extent that predation may affect delta smelt, longfin smelt, and splittail populations is unknown. Predation effects on green sturgeon is unknown.

Food

Food availability and type affect survival of fish species. Species such as threadfin shad and wakasagi may affect delta smelt survival through competition for food. Introduction of nonnative food organisms also may have an effect on survival of delta smelt and other species. Nonnative zooplankton species are more difficult for small smelt and striped bass to capture, increasing the likelihood of larval starvation (Moyle 2002). Splittail feed on opossum shrimp, which in turn feed on native copepods that have shown reduced abundance potentially attributable to the introduction of nonnative zooplankton and the Asiatic clam *Potamorcorbula amurensis*. Severe alterations in the composition and abundance of the primary producer and primary/secondary consumer assemblages in the Delta have been implicated in the recent decline of longfin smelt and other native fish species (U.S. Fish and Wildlife Service 1996; Kimmerer 2002).

In addition, flow affects the abundance of food in the Delta and Suisun Bay. In general, higher flows result in higher productivity, including the higher input of nutrients from channel margin and floodplain inundation and higher production resulting when low salinity occurs in the shallows of Suisun Bay. Higher productivity increases the availability of prey organisms for delta smelt and other fish species.

Entrainment

All fish species are entrained to varying degrees by the State Water Project (SWP) and the Central Valley Project (CVP) Delta export facilities and other diversions in the Delta and Central Valley rivers. Fish entrainment and subsequent mortality is a function of the size of the diversion, the location of the diversion, the behavior and size of the fish, and other factors, such as fish screens, presence of predatory species, and water temperature. Low approach velocities are assumed to minimize stress and protect fish from entrainment.

The CVP and SWP fish facilities indicate entrainment of adult delta smelt during spawning migration from December through April (U.S. Fish and Wildlife Service 1994). Juveniles are entrained primarily from April through June. Young-of-year splittail are entrained between April and August when fish are moving downstream into the estuary (Cech et al. 1979 in Moyle 2002). Juvenile

Chinook salmon are entrained in all months, but primarily from November through June when juveniles are migrating downstream. Green sturgeon are entrained at both facilities during all months of the year, although at low levels (California Department of Fish and Game 2012). Highest entrainment of juvenile longfin smelt at the SWP and CVP pumps occurs during April and May and lowest entrainment of both juveniles and adults is between September and December. Adult entrainment occurs during the fall to winter months (November to January).

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, and local laws, regulations, and policies that pertain to fisheries and aquatics within the program area. Pertinent laws, regulations, and policies are listed below.

- Federal:
  - National Environmental Policy Act
  - Endangered Species Act
  - Magnuson-Stevens Fishery Conservation and Management Act
  - Sustainable Fisheries Act
- State:
  - California Environmental Quality Act
  - California Endangered Species Act
  - Fish and Game Code Section 1602: Streambed Alteration Agreements
- Local:
  - American River Parkway Plan
  - Butte County General Plan
  - Butte Regional Conservation Plan
  - Colusa County General Plan
  - Glenn County General Plan
  - Placer County General Plan
  - Sacramento County General Plan
  - Solano County General Plan
  - Sutter County General Plan
  - Tehama County General Plan
  - Yolo County General Plan
  - Yuba County General Plan

Determination of Effects

The proposed program would involve short-term construction activities and long-term changes to bank structure that potentially could affect aquatic species, including fish, and fish habitat in the program area. Although other fish species potentially would be affected by the proposed program, this chapter focuses primarily on fish species listed under ESA and CESA.

The specific environmental conditions and fish species included in this analysis adequately addresses the full range of conditions and fish species potentially affected because the response of the selected species to program actions is an indicator of the potential response by other species. Mitigation measures that reduce effects on the species discussed are also likely to reduce effects on the other species. Where the location and timing of program actions and the potential effects on a fish species or habitat are not captured by the analysis for the selected species, the specific effects on other species are described.

Assessment Methods

The effects assessment consists of two main sections. The first section is a qualitative evaluation of short-term effects occurring during construction. The second section uses the Standard Assessment Methodology (SAM) (U.S. Army Corps of Engineers 2004) to quantitatively estimate program effects immediately after construction and up to 50 years in the future.

Qualitative Evaluation of Short-Term Effects during Construction

A qualitative evaluation of potential short-term effects during construction was made. This evaluation describes the potential short-term effects associated with construction and relates them to associated changes in fish ecology that may be significant, based on a review of relevant literature.

Standard Assessment Methodology for Long-Term Effects

The SAM was used to determine potential program-level effects of the SRBPP Phase II Additional Authorization and compensation requirements. SAM assesses changes in habitat condition for various focus fish species as a result of levee improvement or bank protection actions within the program area. The habitat variables included in the analysis describe features of the river bank and nearshore habitat that are important to fish survival: bank slope, floodplain availability, bank substrate size, instream structure, aquatic vegetation, and overhanging shade. The SAM Electronic Calculation Template (ECT) Version 3.0 beta edition (June 2009) developed for and in conjunction with the Corps and the Central Valley Flood Protection Board by Stillwater Sciences was used in the analysis. The focus fish species included in the analysis were the Sacramento River winter-run Chinook salmon ESU, the Central Valley spring-run Chinook salmon ESU, the Central Valley fall- and late fall–run Chinook salmon ESU, the Central Valley steelhead DPS, delta smelt, and the green sturgeon southern DPS.

Data for the SAM analysis were derived from the Corps revetment database (2007). GIS data from the revetment database were merged with GIS data for the more than 150 erosion sites (Ayres Associates and U.S. Army Corps of Engineers 2008) to derive values for individual sites within each program region (1a, 1b, 2, and 3). Following Stillwater Sciences (2007), data for each program region were averaged from all the sites within each region (with a weighting for site length) to give regional averages for the existing conditions. The change in fish habitat in each program region was compared with baseline conditions, beginning from the time of construction to 50 years into the future, with changes at 1, 5, 10, 15, and 25 years post-construction also included.

Alternatives for potential bank protection designs to be used within each region were determined from the assessment of 106 sites originally evaluated in the SRBPP Alternatives Analysis (Kleinefelder-Geomatrix 2009) and further evaluated and refined in the Engineering Documentation Report (EDR) (HDR 2009). Site designs presented in the EDR reflect the Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, ETL 1110-2-583 (Vegetation ETL), resulting in the identification of sites that would not be planted with vegetation and where the vegetation-free state would be maintained throughout the life of the site in order to comply with the Vegetation ETL (U.S. Army Corps of Engineers 2014). The No Action Alternative was compared with baseline conditions in all regions; the remaining alternatives were considered only if they were deemed to be feasible or desirable in a given region based on the EDR assessment. For the No Action Alternative it was assumed that a certain amount of erosion would occur over time, leading to changes in bank slope, shade, and quantity of woody debris in each region. Submerged vegetation was also assumed to change, generally increasing.

Full methods and region-specific results of the SAM analysis are provided in Appendix F, Standard Assessment Methodology (SAM) Analysis Process.

Significance Criteria

Populations of fish and other aquatic organisms may be reduced because of increased mortality and changes in habitat availability and suitability that affect survival, growth, migration, and reproduction. In general, effects on fish populations are significant when the project causes or contributes to substantial short- or long-term reductions in abundance and distribution. The assessment of potential effects takes into consideration the significance of an action based on its context and its intensity, as required by NEPA. Based on CEQA Guidelines (Section 15065), Appendix G of the State CEQA Guidelines, and NEPA regulations an effect is found to be significant if it:

- Has a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the DFW or USFWS;
- Interferes substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- Substantially reduces the habitat of a fish population;
- Causes a fish population to drop below self-sustaining levels;
- Threatens to eliminate an animal community;
- Reduces the number or restricts the range of a rare or endangered fish species; or

- Has considerable cumulative effects when viewed with past, current, and reasonably foreseeable future projects.

In this effect assessment, effects were considered significant if it was determined that existing conditions would be worsened by program construction, resulting in a substantial reduction in population abundance, movement, and distribution. The definition of a "substantial" reduction varies with each species, depending on the ability of the population to maintain or exceed current production levels through mechanisms that compensate for reduced abundance of earlier life stages. Many fish populations are resilient in the face of mortality caused by human activities and can sustain high levels of exploitation. Given the focus on listed species, a precautionary approach was adopted in which even small effects were regarded as potentially significant. The quantitative analysis using SAM took into consideration different fish life stages and also the life span of the species when considering the significance of the effects. The proposed program could be considered to be self-mitigating if, because of site design, short-term habitat deficits were fully compensated by subsequent increases over a period approximating the life span or time to maturity of each species. These periods were 5 years (Chinook salmon), 4 years (steelhead), 2 years (delta smelt), and 15 years (green sturgeon).

Effects and Mitigation Measures

Short-Term Effects

Alternative 1—No Action

Under Alternative 1, it is assumed that there would be no short-term effects on fisheries and aquatics. Current bank and levee maintenance activities, such as mowing and application of herbicides, would continue, and any effects from these activities would not be different from current (baseline) conditions. Potential long-term effects (e.g., because of gradual erosion) are discussed below in *Long-Term Effects*.

Alternative 2A—Low Maintenance

Effect FISH-1: Short-Term Effects of Rock Placement into Nearshore Aquatic Habitat during Construction

Rock placement may directly kill fish by crushing but is most likely to disturb fish by increasing noise, water turbulence, and turbidity, causing them to move away from the area of placement.

Salmonids

Rock placement may cause juvenile salmonids to avoid the construction area and make them more susceptible to predation. NMFS (2008a) describes various studies suggesting that juvenile Chinook salmon are more susceptible to predation after avoiding construction areas. The effect is likely to be similar for juvenile steelhead, although most individuals are somewhat larger than juvenile Chinook during migration and so may be less susceptible to predation. NMFS (2008a) also notes that, of the various races of Chinook salmon, winter-run may be most susceptible to crushing by placed rocks (in Region 3) because fry-sized individuals are present from August to December in Region 3 of the program area. Increased noise because of construction could affect migrating salmonid adults but the effect is not likely to be severe because salmonid adults tend to migrate during crepuscular periods and occupy deeper waters of the mid channel (NMFS 2008a).

Green Sturgeon

As with salmonids, adult or juvenile green sturgeon could be killed or injured by rock placement but NMFS (2008a) did not expect this to affect many individuals because the species is generally benthic and less susceptible to activities at the shoreline.

Delta Smelt

As with salmonids, delta smelt could be killed or injured by rock placement or may be more susceptible to predation. However, this effect is probably minimal because the species tends to occupy pelagic areas away from the shoreline (Nobriga et al. 2004) and construction activities would not occur during spawning (January–July), which is the period during which adults may be closer to shore (Moyle 2002).

Longfin Smelt

As with delta smelt, longfin smelt are unlikely to be affected by rock placement activities. However, spawning may occur as early as November (Moyle 2002) and so could potentially be affected during the final month of construction activity. The bulk of spawning activity is from December to June and would avoid the construction period; juvenile rearing would not be likely to be affected because construction in the Delta region would commence in August, by which time juveniles will have migrated downstream of the program area.

Sacramento Splittail

The potential exists for adult or juvenile Sacramento splittail to be significantly affected by rock placement for the same reasons given for salmonids and smelts above. The species spawns in nearshore habitats of the Delta and lower Sacramento River, which is also where larvae are found, and juveniles move to areas away from the shore (Wang 1986). The primary period of nearshore occupation is during the spring and would avoid the construction period.

Conclusion

The short-term effect of rock placement is significant for salmonids, steelhead, delta smelt, longfin smelt, and Sacramento splittail but would be adequately mitigated by Mitigation Measure FISH-MM-1 to a level that is less than significant.

Mitigation Measure FISH-MM-1: Limit Construction Activity to Periods of the Year That Minimize Effects on Fish

Construction will be limited to the period from July 1 to November 30 at all sites except those in the Delta. This will minimize project effects by avoiding the main periods of migration for juvenile salmonids. Construction will be limited to the period from August 1 to November 30 at sites in the Delta (below RM 60 of the Sacramento River), which will minimize effects on most spawning and rearing delta smelt, longfin smelt, and Sacramento splittail, as well as minimizing effects on salmonids.

Effect FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction

Program construction may disturb soils and the nearshore environment, leading to increases in sediment in the nearshore aquatic habitat. This in turn may increase sedimentation (i.e., deposition of sediment on the substrate), suspended sediments, and turbidity. Increases in suspended solids and turbidity would generally be short-term in nature. Very high concentrations of suspended solids may interfere with respiration.

Salmonids

Increased sedimentation and turbidity as a result of program construction activities may affect fish behavior by influencing spawning, feeding, or migratory behavior. The survival to emergence of fertilized salmonid eggs decreases with increased sedimentation (Shapovalov and Taft 1954, Cordone and Kelley 1961, Bjornn and Reiser 1991). Sedimentation could, therefore, reduce the quantity of available spawning habitat. However, little salmonid spawning habitat is located within the program area and is instead mostly upstream. The amount of habitat for juvenile fish (particularly salmonids) may decrease as sediment settles and fills in spaces between larger cobbles and boulders that are normally used for refuge (Cordone and Kelley 1961, Bjornn and Reiser 1991). Easily accessible invertebrate prey normally found on rocks may be replaced by burrowing organisms, reducing the amount of prey for juvenile salmonids (Bjornn and Reiser 1991). This effect is most relevant to areas upstream of the program area but, nevertheless, could be locally important within the program area.

Program construction may increase turbidity in the adjacent water bodies. Short-term periods of higher turbidity generally do not affect larger juveniles and adults (Cordone and Kelley 1961). For smaller juvenile salmonids, increased turbidity may result in decreased growth because of reduced visual foraging ability and earlier emigration from a water body (Sigler et al. 1984). Smaller size at emigration may increase vulnerability to predation. Migrating adult salmonids may avoid highly turbid water and may not be able to access suitable spawning habitat. For example, Cordone and Kelley (1961: 195) cite studies documenting avoidance of turbid Yuba River waters by migrating Chinook salmon adults; the movement of the salmon into a small tributary of the Yuba River led to considerable disturbance of previously constructed redds (nests) by subsequent spawners because the number of spawners exceeded the amount of habitat.

Increased construction-related suspended sediments may produce a variety of behavioral and physiological effects in salmonids. Newcombe and Jensen (1996) noted that concentration and duration of exposure were of importance in determining effects and modeled response exposure in terms of behavioral effects (ranging from an alarm reaction to avoidance), sublethal effects (ranging from short-term reductions in feeding success to long-term reductions in feeding success), and lethal or paralethal effects (ranging from reduced growth/feeding/density to 80–100% mortality). For adult and juvenile salmonids, Newcombe and Jensen calculated that for a very short-term exposure (1 hour), sublethal effects began at around 20 mg/l (milligrams per liter) of suspended solids and lethal/paralethal effects began at around 20,000 mg/l.

Green Sturgeon

NMFS (2008a) noted that short-term increases in suspended sediments or turbidity were unlikely to affect green sturgeons' foraging success because the species uses olfactory cues as opposed to vision. As noted above, the species is benthic and so is unlikely to be present in nearshore areas. Spawning habitat for green sturgeon is mostly upstream of the program area and in waters of 3 meters or more (Moyle 2002), so spawning is unlikely to be affected by the shoreline rock placement.

Delta Smelt

Delta smelt are found in relatively turbid water, possibly because predation by visual predators is reduced (Nobriga et al. 2008). Increased turbidity may decrease feeding opportunities and increased suspended solids could clog and abrade gill filaments (U.S. Fish and Wildlife Service 2008).

Longfin Smelt

Effects of increased turbidity and suspended solids are likely to be similar to those described above for delta smelt, because the species have sufficiently similar biology for similar responses to be inferred.

Sacramento Splittail

Effects of increased turbidity and suspended solids are likely to be similar to those described above for delta smelt, because the species have sufficiently similar biology for similar responses to be inferred.

Conclusion

Effects related to increases in sedimentation, suspended solids, and turbidity would be significant for all species (with the possible exception of green sturgeon) but would be adequately mitigated to a level that is less than significant by adopting Mitigation Measure WQ-MM-1: Monitor Turbidity during Construction, described in Chapter 5, and Mitigation Measure FISH-MM-1.

Effect FISH-3: Spillage and Leakage of Contaminants during Construction

Accidental spillage or leakage of contaminants such as gasoline, lubricants, and other petroleum-based products could kill or injure fish populations in the program area, as well as making them more susceptible to disease and other forms of mortality (National Marine Fisheries Service 2008a).

Salmonids

Salmonids would be negatively affected by increased levels of petroleum-based contaminants. Juveniles in particular would be affected by contamination of the nearshore environment, whereas adults tend to be farther from shore and may not be as susceptible. Moles et al. (1981) found that growth of juvenile coho salmon fry (*Oncorhynchus kisutch*) was slowed by exposure to sublethal doses of two refined oil constituents, toluene and naphthalene. The response of juvenile salmonids in the program area is likely to be similar.

Green Sturgeon

As with salmonids, exposure to contaminants would probably be detrimental to green sturgeon. Likelihood of exposure is reduced by the species' benthic habitat and relatively infrequent occurrence in nearshore habitat (National Marine Fisheries Service 2008a).

Delta Smelt

There is relatively little information on the effects of contaminants on delta smelt (Bennett 2005), but it can be assumed that exposure to petroleum-based products could kill or injure delta smelt, as noted for salmonids above. Additionally, contaminants could reduce the extent of vegetated nearshore habitat believed to be important for delta smelt spawning and early life history.

Longfin Smelt

Effects of increased contaminant levels are likely to be similar to those described above for delta smelt, because the species have sufficiently similar biology for similar responses to be inferred.

Sacramento Splittail

Effects of increased contaminant levels are likely to be similar to those described above for delta smelt, because the species have sufficiently similar biology for similar responses to be inferred.

Conclusion

Effects related to spillage and leakage of contaminants would be significant but would be adequately mitigated to a level that is less than significant by adopting Mitigation Measures FISH-MM-1 and WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality, described in Chapter 5.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect FISH-1 would not occur under Alternative 3A because this alternative does not involve the placement of any rock.

Effect FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction

Effect FISH-2, as described above under Alternative 2A, has the potential to occur under Alternative 3A, though construction of setback and adjacent levees would have a significantly lower likelihood of disturbing soils near the water because most of the work would be implemented on the landside of the existing levee. Potential increases in suspended solids and turbidity would be considered a significant effect, but implementation of Mitigation Measures WQ-MM-1 and FISH-MM-1 would reduce the effect to a level that is less than significant.

Effect FISH-3: Spillage and Leakage of Contaminants during Construction

As described under Alternative 2A, accidental spillage or leakage of contaminants could kill or injure fish populations in the program area. However, the likelihood of contaminants entering waterways under Alternative 3A is much lower than under Alternative 2A because most of the work would be implemented on the landside of the existing levee. Effects related to the spillage and leakage of contaminants either directly or indirectly into adjacent waters would be considered significant, but would be adequately mitigated to a level that is less than significant by implementing Mitigation Measures WQ-MM-2 and FISH-MM-1.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect FISH-1: Short-Term Effects of Rock Placement into Nearshore Aquatic Habitat during Construction

Effect FISH-1, as described under Alternative 2A, has the potential to occur under Alternative 4A, but to a lesser extent because Alternative 4A calls for less rock placement than Alternative 2A. The short-term effect of rock placement would be significant for salmonids, steelhead, delta smelt, longfin smelt, and Sacramento splittail, but would be adequately mitigated to a level that is less than significant by implementation of Mitigation Measure FISH-MM-1.

Effect FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction

Effect FISH-2, as described under Alternative 2A, has the potential to occur under Alternative 4A, but to a lesser extent because Alternative 4A calls for less work in and near the water than Alternative 2A. Effects related to increases in sedimentation, suspended solids, and turbidity are considered significant but would be adequately mitigated to a level that is less than significant by implementing Mitigation Measures WQ-MM-1 and FISH-MM-1.

Effect FISH-3: Spillage and Leakage of Contaminants during Construction

Effect FISH-3, as described under Alternative 2A, has the potential to occur under Alternative 4A, but to a lesser extent because Alternative 4A calls for less work in and near the water than Alternative 2A. Effects related to spillage and leakage of contaminants into adjacent waterways are considered significant but would be adequately mitigated to a level that is less than significant by implementing Mitigation Measures WQ-MM-2 and FISH-MM-1.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect FISH-1: Short-Term Effects of Rock Placement into Nearshore Aquatic Habitat during Construction

Effect FISH-1, as described under Alternative 2A, has the potential to occur under Alternative 5A, but to a lesser extent because Alternative 5A calls for less rock placement than Alternative 2A. The short-term effect of rock placement would be significant for salmonids, steelhead, delta smelt, longfin smelt, and Sacramento splittail, but would be adequately mitigated to a level that is less than significant by implementation of Mitigation Measure FISH-MM-1.

Effect FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction

Effect FISH-2, as described under Alternative 2A, has the potential to occur under Alternative 5A, but to a lesser extent because Alternative 5A calls for less work in and near the water than Alternative 2A. Effects related to increases in sedimentation, suspended solids, and turbidity are considered significant but would be adequately mitigated to a level that is less than significant by implementing Mitigation Measures WQ-MM-1 and FISH-MM-1.

Effect FISH-3: Spillage and Leakage of Contaminants during Construction

Effect FISH-3, as described under Alternative 2A, has the potential to occur under Alternative 5A, but to a lesser extent because Alternative 5A calls for less work in and near the water than Alternative 2A. Effects related to spillage and leakage of contaminants into adjacent waterways are considered significant but would be adequately mitigated to a level that is less than significant by implementing Mitigation Measures WQ-MM-2 and FISH-MM-1.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

FISH-1: Short-Term Effects of Rock Placement into Nearshore Aquatic Habitat during Construction

Effect FISH-1, as described under Alternative 2A, has the potential to occur under Alternative 6A, but to a lesser extent because Alternative 6A calls for less rock placement than Alternative 2A. The short-term effect of rock placement would be significant for salmonids, steelhead, delta smelt, longfin smelt, and Sacramento splittail, but would be adequately mitigated to a level that is less than significant by implementation of Mitigation Measure FISH-MM-1.

Effect FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction

Effect FISH-2, as described under Alternative 2A, has the potential to occur under Alternative 6A, but to a lesser extent because Alternative 6A calls for less work in and near the water than Alternative 2A. Effects related to increases in sedimentation, suspended solids, and turbidity are considered significant but would be adequately mitigated to a level that is less than significant by implementing Mitigation Measures WQ-MM-1 and FISH-MM-1.

Effect FISH-3: Spillage and Leakage of Contaminants during Construction

Effect FISH-3, as described under Alternative 2A, has the potential to occur under Alternative 6A, but to a lesser extent because Alternative 6A calls for less work in and near the water than Alternative 2A. Effects related to spillage and leakage of contaminants into adjacent waterways are considered significant but would be adequately mitigated to a level that is less than significant by implementing Mitigation Measures WQ-MM-2 and FISH-MM-1.

Long-Term Effects

Alternative 1—No Action

As described in Chapter 2, under the No Action Alternative regular operation and maintenance (O&M) of the levee system would continue as presently executed by the local maintaining entities (subject to revision of the governing O&M manual), but the Corps would not implement bank protection along SRFCP levees. The result is likely to be the continued gradual or sporadic loss of remnant floodplain (berm) and the riparian vegetation it supports. The SAM results reflect these changes over time as a result of gradual changes to bank slope, vegetation, and instream structure (Figure 11-1, plus Figures F-1 through F-4 in Appendix F). However, in addition to gradual losses, the erosion could ultimately encroach into the cross-section of the levee foundation, creating critical erosion sites. It is possible that federal, state or local flood control agencies would eventually implement bank protection at various sites along SRFCP levees through emergency action. The SAM results do not take this potential emergency action into account. In any case, the risk of levee failure and possibly catastrophic flooding would increase substantially as more erosion sites become critical and repair is limited to emergency response. Continued erosion prior to the federal or state action would result in short- and long-term losses of valuable habitat. Although some erosion is natural, the channelization of program reaches increases erosive forces.

Alternative 2A—Low Maintenance

Effect FISH-4: Long-Term Effects on Fish from Loss of Habitat

Long-term changes in nearshore habitat are expected to have adverse effects on all special-status fish species. The SAM results indicate moderate to substantial deficits for all species in all seasons with the exception of minor increases for green sturgeon spawning and egg incubation in spring and summer (Figure 11-2, plus Figures F-5 through F-8 in Appendix F). The deficits are generally consistent across all regions, and become more negative over time, with the largest deficits occurring in Year 50.

These deficits reflect the reduction in nearshore habitat value due to permanent removal of instream structure and riparian vegetation throughout all regions during construction. Because of the absence of any vegetation, benches, or IWM in the applied Bank Protection Measure 2: Bank Fill Stone Protection with No On-Site Woody Vegetation, the SAM results indicate there would be no recovery during the analysis period.

While the SAM analysis does not analyze effects on spawning habitat for salmon and steelhead, implementation of Alternative 2A could result in the loss of suitable spawning habitat.

The increase in bank substrate size and reduced shallow water habitat, instream structure, and shade, as well as the potential loss of spawning habitat, would result in a significant effect. Implementation of Mitigation Measures FISH-MM-2, FISH-MM-3, and VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat (see Chapter 10, Vegetation and Wetlands) would reduce the effect on fish species in the area over time. Depending on the extent of the loss, implementation of FISH-MM-2, and VEG_MM-1 may reduce but not fully compensate for effects; therefore, the effect would remain significant and unavoidable.

Focus Fish Species and Water Year	Fall (September–November)					Winter (December–February)					Spring (March–May)					Summer (June–August)				
	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence
Spring-run Chinook																				
2013	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
2014	-638	0	-12	0		-630	0	-31	-333		-636	0	-36	-354		-645	0	-13	-4	
2015	-639	0	-12	3		-629	0	-30	-333		-636	0	-35	-355		-648	0	-12	-5	
2017	-635	0	-9	12		-625	0	-27	-323		-632	0	-29	-348		-651	0	-9	-4	
2018	-633	0	-8	16		-623	0	-25	-317		-629	0	-28	-342		-652	0	-8	-3	
2028	-539	0	-1	41		-534	0	-32	-213		-544	0	-52	-236		-563	0	-1	15	
2038	-489	0	-17	48		-474	0	-65	-322		-496	0	-104	-365		-512	0	-17	23	
2063	-491	0	-34	60		-455	0	-104	-603		-489	0	-161	-689		-508	0	-35	41	
2070	-493	0	-33	62		-458	0	-105	-619		-490	0	-161	-706		-508	0	-33	46	
Fall-run Chinook																				
2013	0	0	0	0		0	0	0	0		0		0	0		0		0	0	
2014	-638	0	-12	0		0	0	-31	-333		-636		0	-354		-645		0	0	
2015	-639	0	-13	3		0	0	-30	-333		-636		1	-355		-648		1	3	
2017	-635	0	-13	12		0	0	-27	-323		-632		7	-348		-651		4	12	
2018	-633	0	-13	16		0	0	-25	-317		-629		9	-342		-652		5	16	
2028	-539	0	-8	36		2	0	-32	-213		-546		18	-243		-563		9	36	
2038	-489	0	-20	35		6	0	-65	-322		-502		19	-383		-512		9	35	
2063	-491	0	-32	26		17	0	-104	-603		-506		26	-737		-508		16	26	
2070	-493	0	-30	24		19	0	-105	-619		-510		29	-761		-508		18	24	
Late fall–run Chinook																				
2013	0		0	0		0		0	0		0		0	0				0	0	
2014	-638		0	-190		-630		0	-333		-636		-36	0				0	0	
2015	-639		0	-191		-629		0	-333		-636		-35	4				0	3	
2017	-635		0	-185		-625		0	-323		-632		-29	17				0	12	
2018	-633		0	-183		-623		0	-317		-629		-28	24				0	16	
2028	-539		2	-38		-534		3	-213		-544		-52	51				2	36	
2038	-489		6	-32		-474		9	-322		-496		-104	51				6	35	
2063	-491		18	-125		-455		23	-603		-489		-161	37				18	26	
2070	-493		21	-127		-458		26	-619		-490		-161	34				21	24	
Winter-run Chinook																				
2013	0		0	0		0		0	0		0		0	0		0		0	0	
2014	-638		-12	-190		-630		-31	-333		-636		-36	-354		-645		-13	-179	
2015	-639		-12	-191		-629		-30	-333		-636		-35	-355		-648		-12	-178	
2017	-635		-9	-185		-625		-27	-323		-632		-29	-348		-651		-9	-174	
2018	-633		-8	-183		-623		-25	-317		-629		-28	-342		-652		-8	-172	
2028	-539		-1	-38		-534		-32	-213		-544		-52	-236		-563		-1	1	
2038	-489		-17	-32		-474		-65	-322		-496		-104	-365		-512		-17	39	
2063	-491		-34	-125		-455		-104	-603		-489		-161	-689		-508		-35	-50	
2070	-493		-33	-127		-458		-105	-619		-490		-161	-706		-508		-33	-57	
Steelhead																				
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
2014	-557	0	-36	-292	-557	-541	0	-70	-414	-541	-553	0	-78	-431	-553	-570		-38	-299	-570
2015	-559	0	-36	-296	-559	-540	0	-68	-414	-540	-553	0	-78	-433	-553	-576		-36	-297	-576
2017	-550	0	-31	-290	-550	-531	0	-63	-406	-531	-545	0	-70	-427	-545	-581		-31	-289	-581
2018	-545	0	-29	-286	-545	-526	0	-59	-403	-526	-539	0	-67	-423	-539	-582		-29	-285	-582
2028	-355	0	-9	-153	-355	-346	0	-63	-315	-346	-365	0	-87	-336	-365	-401		-9	-154	-401
2038	-249	0	-32	-142	-249	-225	0	-113	-390	-225	-261	0	-162	-431	-261	-294		-32	-150	-294
2063	-255	0	-69	-221	-255	-194	0	-186	-611	-194	-254	0	-258	-686	-254	-290		-69	-246	-290
2070	-263	0	-68	-222	-263	-201	0	-188	-624	-201	-260	0	-260	-701	-260	-293		-69	-250	-293
Delta Smelt																				
2013	0				0	0	0	0		0	0	0	0		0	0	0	0		0
2014	0				0	0	0	0		0	0	0	0		0	0	-9	0		0
2015	0				0	0	4	6		0	0	4	6		0	0	-15	4		0
2017	0				0	0	18	28		0	0	18	28		0	0	-22	20		0
2018	0				0	0	26	40		0	0	26	40		0	0	-24	28		0
2028	0				0	0	55	74		0	0	55	75		0	0	-18	52		0
2038	0				0	0	64	82		0	0	64	82		0	0	-10	57		0
2063	0				0	0	74	107		0	0	74	108		0	0	12	74		0
2070	0				0	0	75	115		0	0	76	115		0	0	16	80		0
Green Sturgeon																				
2013			0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
2014			-660	0	-665	0		-660	0	-665	0	0	-660	0	-665	0	0	-668	0	-679
2015			-666	0	-663	0		-666	0	-663	0	0	-666	0	-663	0	0	-681	0	-690
2017			-691	0	-660	0		-691	0	-660	0	0	-691	0	-660	0	0	-720	0	-715
2018			-701	0	-657	0		-701	0	-657	0	0	-701	0	-657	0	0	-738	0	-724
2028			-597	0	-611	0		-604	0	-557	0	0	-604	0	-557	0	0	-649	0	-677
2038			-504	0	-553	0		-513	0	-476	0	0	-513	0	-476	0	0	-555	0	-604
2063			-396	0	-528	0		-407	0	-431	0	0	-407	0	-431	0	0	-434	0	-556
2070			-367	0	-530	0		-379	0	-430	0	0	-379	0	-430	0	0	-401	0	-554

Not Analyzed
>50% Greater
>25%-50% Greater
>10%-25% Greater
5%-10% Greater
<5% Different
5%-10% Less
>10%-25% Less
>25%-50% Less
>50% Less

Graphics ... 00627.08 (6-10-13) AB

ICF INTERNATIONAL

Figure 11-1
Alternative 1 SAM results showing bank-line weighted relative response (feet) within all regions combined

Focus Fish Species and Water Year	Fall (September–November)					Winter (December–February)					Spring (March–May)					Summer (June–August)				
	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence
Spring-run Chinook																				
2013	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
2014	-1,045	0	-195	-494		-970	0	-209	-1,321		-1,027	0	-299	-1,450		-2,071	0	-815	-2,293	
2015	-1,320	0	-372	-981		-1,185	0	-359	-2,129		-1,286	0	-523	-2,354		-2,655	0	-1,113	-3,173	
2017	-1,831	0	-679	-1,907		-1,587	0	-607	-3,501		-1,771	0	-897	-3,901		-3,504	0	-1,455	-4,265	
2018	-2,136	0	-817	-2,376		-1,833	0	-752	-4,314		-2,062	0	-1,112	-4,815		-3,806	0	-1,564	-4,613	
2028	-4,145	0	-1,610	-4,854		-3,326	0	-1,818	-10,029		-3,969	0	-2,668	-11,202		-4,854	0	-1,904	-5,718	
2038	-4,646	0	-1,797	-5,425		-3,690	0	-2,083	-11,464		-4,445	0	-3,053	-12,803		-5,070	0	-1,974	-5,944	
2063	-5,021	0	-1,939	-5,854		-3,963	0	-2,282	-12,539		-4,802	0	-3,344	-14,003		-5,234	0	-2,026	-6,112	
2070	-5,067	0	-1,955	-5,906		-3,998	0	-2,306	-12,672		-4,845	0	-3,380	-14,151		-5,253	0	-2,032	-6,133	
Fall-run Chinook																				
2013	0	0	0	0		0	0	0	0		0		0	0		0		0	0	
2014	-1,045	0	-38	-405		-119	0	-209	-1,321		-901		-234	-1,283		-2,071		-776	-1,975	
2015	-1,320	0	-52	-858		-137	0	-359	-2,129		-1,139		-434	-2,119		-2,655		-1,057	-2,695	
2017	-1,831	0	-63	-1,730		-177	0	-607	-3,501		-1,580		-786	-3,538		-3,504		-1,366	-3,492	
2018	-2,136	0	-79	-2,119		-236	0	-752	-4,314		-1,809		-992	-4,264		-3,806		-1,459	-3,724	
2028	-4,098	0	-364	-3,832		-761	0	-1,818	-10,029		-3,150		-2,306	-9,121		-4,854		-1,733	-4,427	
2038	-4,588	0	-440	-4,213		-893	0	-2,084	-11,464		-3,480		-2,613	-10,351		-5,070		-1,789	-4,570	
2063	-4,954	0	-498	-4,499		-994	0	-2,281	-12,539		-3,727		-2,845	-11,273		-5,234		-1,831	-4,677	
2070	-5,000	0	-505	-4,534		-1,007	0	-2,305	-12,672		-3,757		-2,874	-11,387		-5,253		-1,835	-4,690	
Late fall–run Chinook																				
2013	0		0	0		0		0	0		0		0	0				0	0	
2014	-1,045		-23	-736		-970		-31	-1,321		-1,027		-299	-644				-85	-1,975	
2015	-1,320		-34	-1,254		-1,185		-46	-2,129		-1,286		-523	-1,264				-123	-2,695	
2017	-1,831		-46	-2,188		-1,587		-69	-3,501		-1,771		-897	-2,467				-187	-3,492	
2018	-2,136		-63	-2,653		-1,833		-102	-4,310		-2,062		-1,112	-3,104				-211	-3,724	
2028	-4,010		-227	-5,242		-3,326		-371	-9,644		-3,841		-2,544	-6,313				-283	-4,427	
2038	-4,471		-264	-5,852		-3,690		-432	-10,968		-4,279		-2,893	-7,064				-298	-4,570	
2063	-4,816		-292	-6,310		-3,963		-479	-11,960		-4,608		-3,156	-7,627				-309	-4,677	
2070	-4,859		-295	-6,365		-3,998		-485	-12,084		-4,648		-3,190	-7,696				-310	-4,690	
Winter-run Chinook																				
2013	0		0	0		0		0	0		0		0	0		0		0	0	
2014	-1,045		-195	-736		-970		-209	-1,321		-1,027		-299	-1,450		-2,050		-803	-257	
2015	-1,320		-372	-1,254		-1,185		-359	-2,129		-1,286		-523	-2,354		-2,614		-1,091	-266	
2017	-1,831		-679	-2,188		-1,587		-607	-3,501		-1,771		-897	-3,901		-3,421		-1,414	-289	
2018	-2,136		-817	-2,653		-1,833		-752	-4,314		-2,062		-1,112	-4,815		-3,703		-1,513	-303	
2028	-4,010		-1,553	-5,243		-3,326		-1,738	-9,673		-3,841		-2,547	-10,800		-4,665		-1,822	-358	
2038	-4,471		-1,723	-5,853		-3,690		-1,979	-11,002		-4,279		-2,897	-12,280		-4,864		-1,886	-369	
2063	-4,816		-1,852	-6,312		-3,963		-2,160	-11,997		-4,608		-3,161	-13,390		-5,013		-1,933	-377	
2070	-4,859		-1,868	-6,367		-3,998		-2,183	-12,121		-4,648		-3,195	-13,526		-5,031		-1,938	-378	
Steelhead																				
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
2014	-1,254	0	-304	-821	-1,254	-1,127	0	-353	-1,236	-1,127	-1,227	0	-468	-1,347	-1,227	-3,247		-1,230	-2,231	-3,247
2015	-1,783	0	-555	-1,284	-1,783	-1,557	0	-588	-1,893	-1,557	-1,737	0	-795	-2,091	-1,737	-4,378		-1,684	-2,906	-4,378
2017	-2,772	0	-1,013	-2,107	-2,772	-2,367	0	-992	-2,981	-2,367	-2,687	0	-1,362	-3,335	-2,687	-6,012		-2,234	-3,708	-6,012
2018	-3,361	0	-1,231	-2,522	-3,361	-2,855	0	-1,230	-3,621	-2,855	-3,255	0	-1,691	-4,062	-3,255	-6,587		-2,412	-3,961	-6,587
2028	-7,210	0	-2,515	-5,061	-7,210	-6,020	0	-2,953	-8,182	-6,020	-6,962	0	-4,044	-9,216	-6,962	-8,572		-2,981	-4,796	-8,572
2038	-8,167	0	-2,817	-5,674	-8,167	-6,806	0	-3,380	-9,334	-6,806	-7,883	0	-4,626	-10,516	-7,883	-8,984		-3,097	-4,968	-8,984
2063	-8,884	0	-3,045	-6,134	-8,884	-7,394	0	-3,700	-10,197	-7,394	-8,573	0	-5,063	-11,490	-8,573	-9,292		-3,185	-5,096	-9,292
2070	-8,971	0	-3,073	-6,190	-8,971	-7,467	0	-3,739	-10,302	-7,467	-8,657	0	-5,116	-11,609	-8,657	-9,330		-3,197	-5,112	-9,330
Delta Smelt																				
2013	0				0	0	0	0		0	0	0	0		0	0	0	0		0
2014	0				0	0	-910	-763		0	0	-911	-763		0	0	-2,735	-2,247		0
2015	0				0	0	-1,686	-1,385		0	0	-1,688	-1,387		0	0	-3,664	-2,987		0
2017	0				0	0	-3,104	-2,583		0	0	-3,109	-2,587		0	0	-4,809	-3,876		0
2018	0				0	0	-3,980	-3,326		0	0	-3,988	-3,334		0	0	-5,172	-4,149		0
2028	0				0	0	-9,391	-7,894		0	0	-9,413	-7,914		0	0	-6,337	-4,966		0
2038	0				0	0	-10,717	-8,988		0	0	-10,742	-9,010		0	0	-6,577	-5,132		0
2063	0				0	0	-11,713	-9,808		0	0	-11,740	-9,831		0	0	-6,755	-5,255		0
2070	0				0	0	-11,834	-9,908		0	0	-11,862	-9,932		0	0	-6,777	-5,270		0
Green Sturgeon																				
2013			0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
2014			-942	0	-835	0		-942	0	-958	0	-69	-942	0	-958	0	-13	-1,389	0	-1,662
2015			-1,092	0	-990	0		-1,092	0	-1,130	0	-73	-1,092	0	-1,130	0	50	-1,605	0	-2,094
2017			-1,432	0	-1,311	0		-1,432	0	-1,494	0	-78	-1,432	0	-1,494	0	179	-1,945	0	-2,742
2018			-1,636	0	-1,490	0		-1,636	0	-1,734	0	-87	-1,636	0	-1,734	0	246	-2,044	0	-2,970
2028			-2,189	0	-2,536	0		-2,189	0	-3,240	0	368	-2,189	0	-3,240	0	571	-2,237	0	-3,767
2038			-2,244	0	-2,794	0		-2,244	0	-3,616	0	520	-2,244	0	-3,616	0	642	-2,273	0	-3,932
2063			-2,282	0	-2,987	0		-2,282	0	-3,897	0	634	-2,282	0	-3,897	0	695	-2,298	0	-4,056
2070			-2,288	0	-3,012	0		-2,288	0	-3,933	0	648	-2,288	0	-3,933	0	702	-2,301	0	-4,072

Legend
Not Analyzed
>50% Greater
>25%-50% Greater
>10%-25% Greater
5%-10% Greater
<5% Different
5%-10% Less
>10%-25% Less
>25%-50% Less
>50% Less

Graphics … 00627.08 (6-10-13) AB

Figure 11-2
Alternative 2 SAM results showing bank-line weighted relative response (feet) within all regions combined

Mitigation Measure FISH-MM-2: Compensate for Loss of Fish Habitat

Both on-site and off-site compensation can be used to compensate for the loss of fish habitat (note that only off-site compensation would occur under Alternative 2 because on-site compensation is excluded by the Alternative 2 definition). On-site compensation may include various riparian bench designs, including shallow bench slope designs and/or undulating riparian benches. The riparian benches shall be seasonally inundated during winter and spring high flows. Where no riparian benches will be constructed, bank slope repairs shall be planted with riparian vegetation in accordance with the Vegetation ETL.

IWM and fascines shall be installed at erosion sites with Bank Protection Measures 4a, 4b, and 4c to retain and enhance the structural habitat and hydraulic complexity of the nearshore zones relative to existing conditions. The key objective is to provide essential shaded riverine aquatic (SRA) habitat and velocity refuge opportunities for rearing juveniles. Woody materials shall be installed in accordance with the Vegetation ETL. All installed IWM shall consist of hardwood tree species (e.g., English walnut, almond) that span approximately 15–20 feet in length and retain an extensive branch and root structure. IWM shall be securely anchored under rock revetment at the front edge of the riparian bench or bank toe for both high water winter and spring habitat and for low water summer and fall aquatic habitat. The required specifications for installation of IWM and planting of riparian trees shall be clearly identified in final construction drawings and construction contracts.

Off-site compensation may include the purchase of appropriate third-party mitigation bank credits or will utilize one of five potential measures listed below: setback levees, IWM installation, shallow bank slope construction, riparian planting, and rock removal. The site lengths and/or area per compensation measure necessary to offset long- term habitat losses in each region will be determined during the site-specific analyses, including site-specific SAM analyses, to be conducted during program implementation.

1. The setback levee measure entails breaching or degrading the existing river bank levee and constructing a setback levee some distance landward from the shoreline to restore a seasonally inundated floodplain between the existing levee and newly constructed setback levee. Benefits stem from the expected decrease in bank substrate size, IWM installation and revegetation on the restored floodplain, and from the increase in winter- and spring-time instream and overhead cover.
2. The IWM installation measure simply entails adding woody materials to the banks of the identified compensation sites to provide year-round instream structure. This measure potentially benefits adult, juvenile, and smolt habitat conditions during the modeled time period.
3. Construction of a shallow bank slope (>3:1) at a compensation site would increase available shallow water habitat, potentially offering improved habitat conditions for juveniles and smolts.
4. Planting riparian vegetation along the shoreline of a compensation site would provide shade and improve habitat conditions primarily for juveniles and smolts, but for other life stages as well.

5. Removing rock improves substrate conditions by reducing substrate size and possibly by allowing natural processes, such as erosion and regeneration of vegetation, to occur. This would improve conditions for most life stages, but for juveniles and smolts in particular.

Mitigation Measure FISH-MM-3: Compensate for Loss of Spawning Habitat

A compensatory replacement program shall be implemented for the loss of suitable steelhead spawning habitat at erosion sites on affected rivers. The compensatory replacement program shall result in addition of spawning-size gravel in an amount suitable to account for replacement of the spawning habitat lost by the project. The augmentation of spawning-size gravel shall account for both the actual area lost to each revetment structure footprint and the loss of the steelhead spawning that would potentially occur during the season(s) that the revetments are built. An appropriate replacement ratio shall be determined under consultation with the appropriate natural resource agencies. The location, volume, and design for mitigation gravel shall be selected in close coordination with qualified experts (e.g., fish biologist, geomorphologist). Mitigation may be on-site or off-site, including participation in larger gravel augmentation projects (e.g., U.S. Bureau of Reclamation efforts). The appropriate gravel augmentation approach shall be agreed upon by the project proponents and regulating natural resource agencies prior to construction. Implementation shall include appropriate monitoring for success based on success criteria.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect FISH-4: Long-Term Effects on Fish from Loss of Habitat

Alternative 3A applies either Bank Protection Measure 1: Setback Levee or Bank Protection Measure 3: Adjacent Levee to all sites. Both of these bank protection measures are generally considered protective of fish habitat. Additionally, Bank Protection Measure 1 would create new floodplain habitat that could provide additional benefits for fish. The SAM results for Alternative 3A reflect the different assumptions of the potential bank protection measures (Figure 11-3, plus Figures F-9 through F-12 in Appendix F). In all regions, the Alternative 3A results during the fall and summer solely reflect changes because of erosion, which was assumed to occur at a similar rate as has been observed historically. Differences in winter and spring were driven mostly by the extent of setback levees in a given reach.

In Region 1a, the SAM results show little difference in summer and fall because there were relatively few sites that had exhibited erosion (Appendix F, Figure F-9). In winter and spring, there was appreciably more habitat value for life stages benefitting from floodplain inundation (primarily Chinook salmon fry/juvenile rearing) because a relatively high proportion of the total length of sites (more than 9,000 feet of 28,300 total feet, or 32%) was assumed to have setback levees constructed.

In Region 1b, only 3% (less than 400 feet of a total of 11,000 feet) of the total bank protection measures were assumed to be setback levees, with the result that there was little difference (less than 5%) between baseline and Alternative 3A SAM results in any season for all species and life stages (Appendix F, Figure F-10).

Focus Fish Species and Water Year	Fall (September–November)					Winter (December–February)					Spring (March–May)					Summer (June–August)				
	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence
Spring-run Chinook																				
2013	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
2014	-638	0	-12	0		-630	0	52	-209		-636	0	82	-222		-645	0	-13	-4	
2015	-639	0	-12	3		-629	0	155	-84		-636	0	236	-91		-648	0	-12	-5	
2017	-635	0	-9	12		-625	0	277	60		-632	0	420	65		-651	0	-9	-4	
2018	-633	0	-8	16		-623	0	328	125		-629	0	500	138		-652	0	-8	-3	
2028	-539	0	-1	41		-534	0	561	533		-544	0	829	573		-563	0	-1	15	
2038	-489	0	-17	48		-474	0	578	490		-496	0	849	513		-512	0	-17	23	
2063	-491	0	-34	60		-455	0	573	255		-489	0	843	238		-508	0	-35	41	
2070	-493	0	-33	62		-458	0	576	246		-490	0	849	227		-508	0	-33	46	
Fall-run Chinook																				
2013	0	0	0	0		0	0	0	0		0		0	0		0		0	0	
2014	-638	0	-12	0		0	0	52	-209		-636		107	-222		-645		0	0	
2015	-639	0	-13	3		0	0	155	-84		-636		257	-91		-648		1	3	
2017	-635	0	-13	12		0	0	277	60		-632		438	65		-651		4	12	
2018	-633	0	-13	16		0	0	328	125		-629		518	138		-652		5	16	
2028	-539	0	-8	36		2	0	561	533		-546		847	560		-563		9	36	
2038	-489	0	-20	35		6	0	578	490		-502		912	487		-512		9	35	
2063	-491	0	-32	26		17	0	573	255		-506		969	181		-508		16	26	
2070	-493	0	-30	24		19	0	576	246		-510		978	163		-508		18	24	
Late fall–run Chinook																				
2013	0		0	0		0		0	0		0		0	0				0	0	
2014	-638		0	-190		-630		0	-209		-636		82	102				0	0	
2015	-639		0	-191		-629		0	-84		-636		236	225				0	3	
2017	-635		0	-185		-625		0	60		-632		420	378				0	12	
2018	-633		0	-183		-623		0	125		-629		500	450				0	16	
2028	-539		2	-38		-534		5	533		-544		829	739				2	36	
2038	-489		6	-32		-474		11	490		-496		849	792				6	35	
2063	-491		18	-125		-455		26	255		-489		843	819				18	26	
2070	-493		21	-127		-458		29	246		-490		849	821				21	24	
Winter-run Chinook																				
2013	0		0	0		0		0	0		0		0	0		0		0	0	
2014	-638		-12	-190		-630		52	-209		-636		82	-222		-645		-13	-179	
2015	-639		-12	-191		-629		155	-84		-636		236	-91		-648		-12	-178	
2017	-635		-9	-185		-625		277	60		-632		420	65		-651		-9	-174	
2018	-633		-8	-183		-623		328	125		-629		500	138		-652		-8	-172	
2028	-539		-1	-38		-534		561	533		-544		829	573		-563		-1	1	
2038	-489		-17	-32		-474		578	490		-496		849	513		-512		-17	39	
2063	-491		-34	-125		-455		573	255		-489		843	238		-508		-35	-50	
2070	-493		-33	-127		-458		576	246		-490		849	227		-508		-33	-57	
Steelhead																				
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
2014	-557	0	-36	-292	-557	-541	0	44	-299	-541	-553	0	68	-309	-553	-570		-38	-299	-570
2015	-559	0	-36	-296	-559	-540	0	176	-185	-540	-553	0	244	-192	-553	-576		-36	-297	-576
2017	-550	0	-31	-290	-550	-531	0	330	-59	-531	-545	0	454	-56	-545	-581		-31	-289	-581
2018	-545	0	-29	-286	-545	-526	0	398	0	-526	-539	0	548	8	-539	-582		-29	-285	-582
2028	-355	0	-9	-153	-355	-346	0	715	370	-346	-365	0	951	392	-365	-401		-9	-154	-401
2038	-249	0	-32	-142	-249	-225	0	733	355	-225	-261	0	965	362	-261	-294		-32	-150	-294
2063	-255	0	-69	-221	-255	-194	0	708	179	-194	-254	0	930	155	-254	-290		-69	-246	-290
2070	-263	0	-68	-222	-263	-201	0	710	171	-201	-260	0	935	146	-260	-293		-69	-250	-293
Delta Smelt																				
2013	0				0	0	0	0		0	0	0	0		0	0	0	0		0
2014	0				0	0	148	131		0	0	148	131		0	0	-9	0		0
2015	0				0	0	310	281		0	0	310	281		0	0	-15	4		0
2017	0				0	0	501	464		0	0	501	464		0	0	-22	20		0
2018	0				0	0	587	546		0	0	587	546		0	0	-24	28		0
2028	0				0	0	939	880		0	0	938	878		0	0	-18	52		0
2038	0				0	0	1,016	951		0	0	1,014	949		0	0	-10	57		0
2063	0				0	0	1,077	1,023		0	0	1,075	1,021		0	0	12	74		0
2070	0				0	0	1,084	1,037		0	0	1,083	1,036		0	0	16	80		0
Green Sturgeon																				
2013			0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
2014			-660	0	-665	0		-660	0	-665	0	0	-660	0	-665	0	0	-668	0	-679
2015			-666	0	-663	0		-666	0	-663	0	0	-666	0	-663	0	0	-681	0	-690
2017			-691	0	-660	0		-691	0	-660	0	0	-691	0	-660	0	0	-720	0	-715
2018			-701	0	-657	0		-701	0	-657	0	0	-701	0	-657	0	0	-738	0	-724
2028			-597	0	-611	0		-604	0	-557	0	0	-604	0	-557	0	0	-649	0	-677
2038			-504	0	-553	0		-513	0	-476	0	0	-513	0	-476	0	0	-555	0	-604
2063			-396	0	-528	0		-407	0	-431	0	0	-407	0	-431	0	0	-434	0	-556
2070			-367	0	-530	0		-379	0	-430	0	0	-379	0	-430	0	0	-401	0	-554

Not Analyzed
>50% Greater
>25%-50% Greater
>10%-25% Greater
5%-10% Greater
<5% Different
5%-10% Less
>10%-25% Less
>25%-50% Less
>50% Less

Graphics ... 00627.08 (6-10-13) AB

ICF INTERNATIONAL

Figure 11-3
Alternative 3 SAM results showing bank-line weighted relative response (feet) within all regions combined

In Region 2, the SAM results reflect a complex interaction of assumed species sensitivities to bank features combined with erosion rates at a number of sites that resulted in habitat change (Appendix F, Figure F-11). Thus, for example, the fry/juvenile rearing habitat value for green sturgeon decreased over time because SAM does not assume that this life stage derives any benefit from floodplain availability. In addition, the general pattern of change at eroding sites involved less shade and instream woody material, both of which SAM assumed to have value for this life stage. Chinook salmon fry/juvenile rearing is assumed to benefit greatly from floodplain inundation. The SAM results for Region 2 showed a 5–10% increase in habitat value in the spring and winter by 2028 because more than 20% of total site length was assumed to have setback levees applied. However, the increase was neutralized by 2070 through the assumed erosional loss of other functional riparian habitat, such as shade. Trends for juvenile Chinook salmon migration were similar to those of fry/juvenile rearing, but with no increase because the apparent trade-off in floodplain gain to erosional loss of shade is balanced more towards to the latter.

The SAM results for Region 3 reflect similar trade-offs to those seen in Region 2. Much of the patterns can be explained by the assumed changes at the Sacramento River Mile 163.0L site, which constitutes more than 33% (around 1,200 feet) of the total length analyzed in Region 3. At this site, erosion is assumed to lead to substantial changes in shoreline habitat for fish. Most notable is the assumed loss of inundated vegetation during the winter and spring (from more than 60% cover to 0% cover) between 2018 and 2028, with a resulting decrease in SAM index for this attribute from approximately optimal (1) to around half (0.5) (Appendix F, Figure F-12). This decrease outweighs the increase in habitat value that is assumed to be derived from the construction of setback levees at two other sites on the Sacramento River that total around 1,000 feet. The increase in habitat value from the setbacks at these sites is assumed to be an increase in the SAM index for the floodplain inundation ratio attribute from 0.2 (i.e., an inundation ratio of 1) under baseline conditions to approximately 0.3 (i.e., an inundation ratio of 2) under Alternative 3A.

Implementation of Alternative 3A would allow continued bank erosion, resulting in decreased shade and instream structure over time. This decrease in shade and instream structure would result in a significant effect on listed fish species because these habitat features contribute important ecological functions such as refuge from predators. Implementation of Mitigation Measures FISH-MM-2 and VEG-MM-1 would reduce the effect on fish species in the area to a level that is less than significant.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect FISH-4: Long-Term Effects on Fish from Loss of Habitat

Alternative 4A would have long-term effects on the habitat of listed fish species, including alteration of river hydraulics, instream and overhead cover, and substrate conditions along the seasonal low- and high-flow shorelines of the erosion sites (Figure 11-4, plus Figures F-13 through F-16 in Appendix F). Program implementation would result in temporary losses of instream structure and riparian vegetation along the summer-fall and winter-spring shorelines and would also limit long-term fluvial functioning necessary for the development and renewal of SRA habitat in the future.

Initial cover losses as a result of Alternative 4A would be partially offset by installing riparian plantings along the lower slopes and benches with anchored IWM at many erosion sites. These features would increase the availability of high-value shallow water habitat for juvenile Chinook salmon and steelhead, spawning and incubating delta smelt, and possibly juvenile green sturgeon during the annual high-flow period (late fall, winter, and spring). Assuming an initial reduction in existing shade values, program actions would reduce existing shade by as much as 75%, but eventually (Years 25–50) future shade values would exceed current shade values by up to 75% along the total bank length affected by the program. Further discussion of potential changes in shade that were assumed in the analyses are provided in the *Characterization of With-Project Conditions* section of Appendix F.

At project sites in Region 1a and the lower portion of Region 1b (Sacramento River Miles 20–30), installation of vegetated riparian and wetland benches would further increase shallow-water habitat by adding shallow-water areas that are suitable for rearing by juvenile salmonids, and for spawning, incubation, and rearing by delta smelt. The establishment and growth of planted riparian vegetation is expected to increase habitat values over time by increasing the extent of overhead cover available to listed fish species. At project sites upstream of RM 30, temporary losses of existing IWM would be offset by the placement of additional IWM either above or below the mean summer/fall waterline, resulting in a net increase in IWM at many of those sites. The erosion sites where Bank Protection Measures 2 and 5 are implemented would not have additional IWM installed, resulting in long-term IWM losses.

The program-wide SAM results by species indicate initial negative responses for all salmonid life stages in all seasons over the modeled 50-year period. The initial habitat deficits are the result of riparian vegetation and IWM removal from the program sites during construction. On-site IWM mitigation, installed to replace or exceed pre-project conditions, coupled with riparian vegetation growth would allow habitat for nearly all salmonid life stages to recover to current conditions by Year 50. However, the SAM projects negative adult migration responses through Year 50 in summer and fall for all salmonids and steelhead, as well as in winter for fall-run Chinook salmon. Adult residence for steelhead in summer and fall is also projected to remain negative through Year 50, despite gradual improvements following the initial habitat deficits. Habitat responses are generally improved in winter and spring compared with summer and fall, because of differences between proportions of installed IWM and available aquatic vegetation. During winter and spring, recovery from initial habitat deficits for all salmonid life stages would be complete by Year 25 at the latest, and often much earlier.

Region 1b would experience the greatest negative impacts as a result of site conditions in combination with the bank protection measures applied to those sites.

For delta smelt, the SAM results for Region 1b indicate reductions in habitat values for spawning, incubation, and juvenile rearing (Appendix F, Figure F-14). These deficits are due to temporary increases of bank substrate size and reductions in instream and riparian habitat that are assumed to reduce the availability and suitability of habitat for spawning, incubation, and rearing. As previously described, these life stages are sensitive to changes in bank slope, availability of floodplain, instream structure, and aquatic vegetation. The results in Region 1a are generally positive, with slight decreases in SAM values in the summer (Appendix F, Figure F-13). However, results in Region 1b indicate modest decreases in SAM values that escalate and persist through Year 50. This is primarily the result of those sites within that region that are repaired with Bank Protection Measure 2 (which utilizes an all rock slope and no vegetation) and Bank Protection Measure 5 (which utilizes a rock

Focus Fish Species and Water Year	Fall (September–November)					Winter (December–February)					Spring (March–May)					Summer (June–August)				
	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence
Spring-run Chinook																				
2013	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
2014	-663	0	-18	-20		-582	0	102	-97		-594	0	122	-118		-795	0	-66	-160	
2015	-674	0	-21	-28		-556	0	232	88		-570	0	302	75		-898	0	-98	-275	
2017	-706	0	-24	-60		-565	0	363	237		-577	0	503	245		-1,089	0	-160	-486	
2018	-764	0	-38	-131		-586	0	415	278		-599	0	585	294		-1,162	0	-184	-563	
2028	-1,074	0	-71	-238		-379	0	978	1,412		-367	0	1,386	1,580		-1,241	0	-132	-396	
2038	-745	0	131	-23		-154	0	1,413	2,380		38	0	2,116	2,673		-846	0	94	-117	
2063	-319	0	345	181		115	0	1,941	3,404		490	0	2,839	3,620		-369	0	327	133	
2070	-266	0	373	204		147	0	2,008	3,531		546	0	2,928	3,733		-310	0	357	163	
Fall-run Chinook																				
2013	0	0	0	0		0	0	0	0		0		0	0		0		0	0	
2014	-663	0	-18	0		-3	0	102	-97		-586		94	-101		-795		-53	-15	
2015	-674	0	-22	3		-5	0	232	88		-559		239	97		-898		-80	-27	
2017	-706	0	-28	12		-36	0	363	237		-535		412	315		-1,089		-128	-48	
2018	-764	0	-43	16		-91	0	415	278		-500		468	475		-1,162		-144	-59	
2028	-1,036	0	-86	117		-280	0	978	1,412		-113		787	1,871		-1,241		-116	88	
2038	-702	0	96	204		-262	0	1,413	2,380		222		1,028	2,784		-846		-21	187	
2063	-274	0	289	275		-213	0	1,941	3,404		575		1,262	3,565		-369		77	267	
2070	-220	0	314	283		-207	0	2,008	3,531		618		1,291	3,658		-310		90	275	
Late fall–run Chinook																				
2013	0		0	0		0		0	0		0		0	0				0	0	
2014	-663		-12	-200		-582		-3	-97		-594		122	102				-49	-15	
2015	-674		-18	-207		-556		-4	88		-570		302	225				-72	-27	
2017	-706		-27	-230		-565		-14	237		-577		503	378				-113	-48	
2018	-764		-43	-295		-589		-37	272		-602		583	450				-126	-59	
2028	-961		-81	-124		-404		-42	1,408		-356		1,383	586				-107	88	
2038	-624		-18	463		-187		33	2,333		34		2,075	642				-34	187	
2063	-204		49	1,000		74		135	3,300		466		2,758	681				41	267	
2070	-152		58	1,064		106		148	3,420		519		2,842	684				51	275	
Winter-run Chinook																				
2013	0		0	0		0		0	0		0		0	0		0		0	0	
2014	-663		-18	-200		-582		102	-97		-594		122	-118		-776		-56	-210	
2015	-674		-21	-207		-556		232	88		-570		302	75		-862		-79	-189	
2017	-706		-24	-230		-565		363	237		-577		503	245		-1,017		-125	-175	
2018	-764		-38	-295		-586		415	278		-599		585	294		-1,073		-141	-174	
2028	-959		-21	-124		-379		989	1,468		-329		1,403	1,633		-1,079		-60	-11	
2038	-616		188	469		-154		1,410	2,417		71		2,112	2,714		-688		164	301	
2063	-189		405	1,012		115		1,913	3,407		513		2,810	3,647		-226		393	584	
2070	-136		433	1,078		147		1,977	3,529		568		2,897	3,759		-168		423	619	
Steelhead																				
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
2014	-604	0	-40	-312	-604	-448	0	118	-203	-448	-469	0	132	-222	-469	-855		-112	-349	-855
2015	-625	0	-43	-322	-625	-396	0	292	-36	-396	-421	0	348	-53	-421	-1,053		-162	-352	-1,053
2017	-687	0	-49	-342	-687	-412	0	460	105	-412	-434	0	580	105	-434	-1,410		-260	-385	-1,410
2018	-800	0	-72	-395	-800	-453	0	528	156	-453	-476	0	674	160	-476	-1,544		-300	-407	-1,544
2028	-1,418	0	-101	-437	-1,418	-90	0	1,328	1,067	-90	-25	0	1,737	1,205	-25	-1,724		-193	-156	-1,724
2038	-943	0	257	136	-943	351	0	1,929	1,808	351	657	0	2,690	2,122	657	-1,125		200	310	-1,125
2063	-375	0	633	690	-375	868	0	2,636	2,614	868	1,352	0	3,627	2,946	1,352	-467		605	742	-467
2070	-305	0	680	758	-305	933	0	2,727	2,715	933	1,439	0	3,744	3,047	1,439	-386		656	795	-386
Delta Smelt																				
2013	0				0	0	0	0		0	0	0	0		0	0	0	0		0
2014	0				0	0	161	144		0	0	161	144		0	0	-171	-137		0
2015	0				0	0	330	300		0	0	330	300		0	0	-323	-255		0
2017	0				0	0	460	422		0	0	460	422		0	0	-612	-471		0
2018	0				0	0	413	381		0	0	413	381		0	0	-723	-548		0
2028	0				0	0	-105	97		0	0	-107	96		0	0	-661	-421		0
2038	0				0	0	-228	21		0	0	-231	20		0	0	-593	-364		0
2063	0				0	0	-326	-44		0	0	-330	-46		0	0	-544	-327		0
2070	0				0	0	-339	-52		0	0	-343	-54		0	0	-539	-323		0
Green Sturgeon																				
2013			0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
2014			-560	0	-681	0		-522	0	-861	0	0	-522	0	-861	0	74	-245	0	-774
2015			-504	0	-687	0		-446	0	-957	0	0	-446	0	-957	0	149	-42	0	-852
2017			-470	0	-688	0		-404	0	-1,039	0	-4	-404	0	-1,039	0	298	336	0	-994
2018			-473	0	-686	0		-368	0	-1,131	0	-12	-368	0	-1,131	0	376	524	0	-1,043
2028			883	0	-714	0		1,206	0	-2,771	0	514	1,206	0	-2,771	0	745	1,513	0	-1,188
2038			1,337	0	-720	0		1,694	0	-3,256	0	686	1,694	0	-3,256	0	825	1,716	0	-1,217
2063			1,633	0	-726	0		2,013	0	-3,623	0	816	2,013	0	-3,623	0	884	1,823	0	-1,241
2070			1,667	0	-728	0		2,051	0	-3,667	0	832	2,051	0	-3,667	0	891	1,835	0	-1,244

Not Analyzed
>50% Greater
>25%-50% Greater
>10%-25% Greater
5%-10% Greater
<5% Different
5%-10% Less
>10%-25% Less
>25%-50% Less
>50% Less

Graphics ... 00627.08 (6-10-13) AB

Figure 11-4
Alternative 4 SAM results showing bank-line weighted relative response (feet) within all regions combined

slope and revegetation). In those cases, adverse changes to instream structure and bank slope drive the decreased SAM values. While the revegetation in Bank Protection Measure 5 provides value to several target fish species, SAM does not derive benefits from overhead cover for the delta smelt fry and juvenile rearing life stages.

Green sturgeon adult residence would experience deficits in almost all seasons. This is the result of SAM deriving negative results for the adult residence life stage resulting from the changes in slope, which are primarily associated with the bench designs of Bank Protection Measures 4a, 4b, and 4c. While these changes in slope would occur, the proposed bank protection measures typically would not affect (e.g., change the slope of) the deeper parts of the channel that are utilized by adult green sturgeon.

Implementation of Alternative 4A is expected to increase habitat values over time by increasing the extent of overhead cover and high-quality shallow water habitat available to listed fish species. However, this alternative would limit long-term fluvial functioning necessary for the development and renewal of SRA habitat in the future. Alternative 4A is expected to negatively affect summer and fall adult salmonid migration, winter migration of fall-run Chinook salmon, and adult steelhead residence. The SAM also predicts negative effects on delta smelt in Region 1b due to changes in bank slope and instream structure. These long-term effects on listed fish species would be considered significant. Implementation of Mitigation Measures FISH-MM-2, FISH-MM-3, and VEG-MM-1 would reduce the effect on fish species in the area to a level that is less than significant.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect FISH-4: Long-Term Effects on Fish from Loss of Habitat

Effects under Alternative 5A would be very similar to those previously described for Alternative 4A. Alternative 5A would have long-term effects on the habitat of listed fish species, including alteration of river hydraulics, instream and overhead cover, and substrate conditions along the seasonal low- and high-flow shorelines of the erosion sites (Figure 11-5, plus Figures F-17 through F-20 in Appendix F). Implementation of the program would result in temporary losses of instream structure and riparian vegetation along the summer-fall and winter-spring shorelines and would also limit long-term fluvial functioning necessary for the development and renewal of SRA habitat in the future. However, Alternative 5A would include several setback and adjacent levees and incorporate riparian benches into numerous sites. These setback and adjacent levees would protect or create valuable fish habitat.

Alternative 5A differs from Alternative 4A in that a number of the bank protection measures applied to the representative 106 sites were changed to specifically reduce the adverse effects on fish as determined by the SAM analysis. For example, some sites that utilized Bank Protection Measure 2 under Alternative 4A were changed to utilize Bank Protection Measure 1 under Alternative 5A. Similarly, some sites changed from Bank Protection Measure 4a to Bank Protection Measure 3, or Bank Protection Measure 5 changed to Bank Protection Measure 4b. All of these changes were made to reduce the adverse effects on fish as identified in the SAM analysis of Alternative 4A. As a result, the same types of impacts occur under Alternative 5A as under Alternative 4A, but to a somewhat lesser degree.

In general, the SAM results for Alternative 5A become positive sooner (e.g., Year 15 instead of Year 25) and positive values in Year 50 are somewhat greater than under Alternative 4A. Additionally, while some SAM deficits persist through Year 50 under Alternative 4A for certain salmonid and steelhead life stages, those results become positive under Alternative 5A when considering program-wide SAM results. Region 3 alone has deficits that persist through Year 50 as a result of the erosion that is assumed to lead to substantial changes in shoreline habitat for fish. As previously described under Alternative 3A, the assumed loss of inundated vegetation in the winter and spring drives the SAM deficits. While the deficits under 5A are less than those under 3A as a result of additional setback levees, the deficits persist.

The increase in bank substrate size and reduced shallow water habitat, instream structure, and shade, as well as the potential loss of spawning habitat, would result in a significant effect. Implementation of Mitigation Measures FISH-MM-2, FISH-MM-3, and VEG-MM-1 would reduce the effect on fish species in the area to a level that is less than significant.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect FISH-4: Long-Term Effects on Fish from Loss of Habitat

Similar to Alternative 4A, Alternative 6A would have long-term effects on the habitat of listed fish species, including alteration of river hydraulics, instream and overhead cover, and substrate conditions along the seasonal low- and high-flow shorelines of the erosion sites (Figure 11-6, plus Figures F-21 through F-24 in Appendix F). Implementation of the program would result in temporary losses of instream structure and riparian vegetation along the summer-fall and winter-spring shorelines and would also limit long-term fluvial functioning necessary for the development and renewal of SRA habitat in the future.

Initial cover losses as a result of Alternative 6A would be partially offset by installing riparian plantings along the lower slopes and benches with anchored IWM at a majority of the erosion sites. These features would increase the availability of high-value shallow water habitat for juvenile Chinook salmon and steelhead, spawning and incubating delta smelt, and possibly juvenile green sturgeon during the annual high-flow period (late fall, winter, and spring). Assuming an initial reduction in existing shade values, program actions would reduce existing shade by as much as 75%, but eventually (Years 25–50) future shade values would exceed current shade values by up to 75% along the total bank length affected by the proposed program.

At project sites in Regions 1a and the lower portion of Region 1b (Sacramento River Miles 20–30), installation of vegetated riparian and wetland benches would further increase shallow-water habitat by adding shallow-water areas that are suitable for rearing by juvenile salmonids, and for spawning, incubation, and rearing by delta smelt. The establishment and growth of planted riparian vegetation is expected to increase habitat values over time by increasing the extent of overhead cover available to listed fish species. At project sites upstream of RM 30, temporary losses of existing IWM would be offset by the placement of additional IWM either above or below the mean summer/fall waterline, resulting in a net increase in IWM at many of those sites. The erosion sites where Bank Protection Measures 2 and 5 are implemented would not have additional IWM installed, resulting in long-term IWM losses.

Focus Fish Species and Water Year	Fall (September–November)					Winter (December–February)					Spring (March–May)					Summer (June–August)				
	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence
Spring-run Chinook																				
2013	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
2014	-648	0	-24	-20		-615	0	60	-190		-626	0	81	-210		-638	0	-35	-58	
2015	-653	0	-30	-28		-606	0	169	-55		-619	0	237	-70		-615	0	-32	-72	
2017	-613	0	-21	-24		-556	0	323	193		-567	0	457	196		-578	0	-27	-97	
2018	-554	0	-9	-19		-491	0	424	422		-501	0	590	436		-584	0	-30	-109	
2028	-516	0	76	255		-56	0	1,146	2,110		-68	0	1,538	2,243		-554	0	65	218	
2038	-241	0	268	504		159	0	1,543	2,951		273	0	2,183	3,174		-265	0	262	482	
2063	109	0	464	728		395	0	2,004	3,826		648	0	2,821	3,986		96	0	462	716	
2070	156	0	490	754		426	0	2,065	3,954		697	0	2,904	4,106		145	0	488	744	
Fall-run Chinook																				
2013	0	0	0	0		0	0	0	0		0		0	0		0		0	0	
2014	-648	0	-24	0		-3	0	60	-190		-618		94	-193		-638		-27	-4	
2015	-653	0	-31	3		-5	0	169	-55		-608		239	-48		-615		-29	-5	
2017	-613	0	-25	12		-5	0	323	193		-557		424	212		-578		-34	-5	
2018	-554	0	-14	16		-2	0	424	422		-494		513	441		-584		-37	-4	
2028	-478	0	51	187		5	0	1,146	2,110		-102		991	1,926		-554		26	180	
2038	-198	0	221	290		45	0	1,543	2,951		163		1,242	2,648		-265		116	286	
2063	154	0	395	373		102	0	2,004	3,826		445		1,479	3,277		96		207	371	
2070	201	0	418	382		109	0	2,065	3,954		483		1,508	3,374		145		219	380	
Late fall–run Chinook																				
2013	0		0	0		0		0	0		0		0	0				0	0	
2014	-648		-12	-209		-615		-3	-190		-626		81	102				-24	-4	
2015	-653		-18	-220		-606		-4	-55		-619		237	225				-24	-5	
2017	-613		-21	-171		-556		-3	193		-567		457	378				-25	-5	
2018	-554		-21	-102		-494		1	416		-504		588	450				-26	-4	
2028	-403		21	571		-82		103	2,106		-57		1,534	699				22	180	
2038	-120		88	1,116		126		187	2,904		269		2,143	782				89	286	
2063	223		157	1,600		355		288	3,722		622		2,739	842				157	371	
2070	269		166	1,665		385		301	3,842		669		2,817	848				166	380	
Winter-run Chinook																				
2013	0		0	0		0		0	0		0		0	0		0		0	0	
2014	-648		-24	-209		-615		60	-190		-626		81	-210		-620		-26	-110	
2015	-653		-30	-220		-606		169	-55		-619		237	-70		-578		-13	-44	
2017	-613		-21	-171		-556		323	193		-567		457	196		-507		9	72	
2018	-554		-9	-102		-491		424	422		-501		590	436		-495		13	102	
2028	-401		126	571		-56		1,158	2,166		-30		1,555	2,296		-392		136	326	
2038	-112		326	1,122		159		1,538	2,988		306		2,180	3,215		-107		332	607	
2063	238		525	1,612		395		1,977	3,828		670		2,792	4,013		240		528	847	
2070	284		551	1,678		426		2,035	3,952		718		2,871	4,131		287		554	878	
Steelhead																				
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
2014	-574	0	-54	-311	-574	-512	0	57	-271	-512	-531	0	70	-288	-531	-545		-62	-250	-545
2015	-584	0	-62	-323	-584	-495	0	198	-141	-495	-517	0	252	-156	-517	-493		-50	-203	-493
2017	-502	0	-45	-278	-502	-394	0	402	77	-394	-415	0	516	75	-415	-405		-31	-122	-405
2018	-385	0	-20	-220	-385	-265	0	548	271	-265	-283	0	690	277	-283	-407		-32	-107	-407
2028	-296	0	150	162	-296	547	0	1,609	1,654	547	584	0	1,989	1,753	584	-352		140	176	-352
2038	138	0	473	653	138	978	0	2,154	2,298	978	1,185	0	2,822	2,520	1,185	105		469	528	105
2063	638	0	806	1,124	638	1,448	0	2,763	2,976	1,448	1,787	0	3,627	3,211	1,787	620		803	858	620
2070	703	0	848	1,188	703	1,509	0	2,842	3,074	1,509	1,867	0	3,733	3,311	1,867	689		846	906	689
Delta Smelt																				
2013	0				0	0	0	0		0	0	0	0		0	0	0	0		0
2014	0				0	0	161	144		0	0	161	144		0	0	-52	-18		0
2015	0				0	0	330	300		0	0	330	300		0	0	-85	-16		0
2017	0				0	0	524	486		0	0	524	486		0	0	-147	-5		0
2018	0				0	0	619	587		0	0	619	587		0	0	-178	-2		0
2028	0				0	0	850	1,051		0	0	849	1,051		0	0	122	361		0
2038	0				0	0	885	1,135		0	0	885	1,135		0	0	238	465		0
2063	0				0	0	907	1,188		0	0	906	1,188		0	0	320	537		0
2070	0				0	0	908	1,195		0	0	907	1,195		0	0	330	546		0
Green Sturgeon																				
2013			0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
2014			-661	0	-665	0		-669	0	-747	0	0	-669	0	-747	0	82	-304	0	-621
2015			-653	0	-664	0		-665	0	-786	0	0	-665	0	-786	0	164	65	0	-576
2017			-509	0	-619	0		-571	0	-848	0	0	-571	0	-848	0	327	761	0	-499
2018			-325	0	-555	0		-447	0	-962	0	0	-447	0	-962	0	409	1,033	0	-486
2028			1,474	0	-449	0		1,287	0	-2,647	0	551	1,287	0	-2,647	0	789	2,183	0	-488
2038			2,006	0	-438	0		1,810	0	-3,124	0	728	1,810	0	-3,124	0	872	2,432	0	-497
2063			2,381	0	-434	0		2,179	0	-3,487	0	862	2,179	0	-3,487	0	933	2,593	0	-507
2070			2,426	0	-434	0		2,224	0	-3,532	0	878	2,224	0	-3,532	0	940	2,614	0	-509

Not Analyzed
>50% Greater
>25%-50% Greater
>10%-25% Greater
5%-10% Greater
<5% Different
5%-10% Less
>10%-25% Less
>25%-50% Less
>50% Less

Graphics … 00627.08 (6-10-13) AB

ICF INTERNATIONAL

Figure 11-5
Alternative 5 SAM results showing bank-line weighted relative response (feet) within all regions combined

Focus Fish Species and Water Year	Fall (September–November)					Winter (December–February)					Spring (March–May)					Summer (June–August)				
	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence	Adult migration	Spawning and egg incubation	Fry and juvenile rearing	Juvenile migration	Adult residence
Spring-run Chinook																				
2013	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
2014	-716	0	-70	123		-580	0	59	-107		-633	0	-21	-212		-995	0	-439	-552	
2015	-781	0	-139	193		-552	0	122	69		-643	0	-17	-115		-1,167	0	-551	-618	
2017	-887	0	-169	424		-554	0	252	352		-677	0	96	101		-1,458	0	-626	-465	
2018	-983	0	-172	576		-560	0	327	501		-705	0	153	202		-1,567	0	-629	-281	
2028	-1,366	0	4	1,922		-180	0	1,240	2,765		-315	0	1,173	2,400		-1,606	0	-174	1,608	
2038	-757	0	588	2,877		121	0	1,811	4,135		276	0	2,156	3,926		-901	0	481	2,689	
2063	-11	0	1,161	3,712		469	0	2,463	5,516		935	0	3,125	5,248		-83	0	1,108	3,617	
2070	82	0	1,232	3,814		513	0	2,547	5,688		1,017	0	3,245	5,409		20	0	1,185	3,732	
Fall-run Chinook																				
2013	0	0	0	0		0	0	0	0		0		0	0		0		0	0	
2014	-716	0	-18	143		-3	0	59	-107		-625		-49	-195		-995		-426	-418	
2015	-781	0	-22	224		-5	0	122	69		-632		-80	-93		-1,167		-533	-391	
2017	-887	0	-28	496		-36	0	252	351		-635		6	171		-1,458		-594	-65	
2018	-983	0	-37	698		-83	0	327	501		-614		36	353		-1,567		-589	168	
2028	-1,328	0	-34	2,029		-210	0	1,240	2,765		-130		574	2,454		-1,606		-158	1,837	
2038	-713	0	189	2,774		-178	0	1,811	4,135		368		1,069	3,742		-901		365	2,659	
2063	33	0	420	3,409		-117	0	2,463	5,515		907		1,548	4,853		-83		857	3,352	
2070	128	0	450	3,487		-110	0	2,547	5,688		974		1,608	4,988		20		918	3,437	
Late fall–run Chinook																				
2013	0		0	0		0		0	0		0		0	0				0	0	
2014	-716		-12	-57		-580		-3	-107		-633		-21	8				-47	-418	
2015	-781		-18	14		-552		-4	69		-643		-17	35				-70	-391	
2017	-887		-27	254		-554		-14	352		-677		96	234				-112	-65	
2018	-983		-37	412		-563		-28	495		-708		151	328				-124	168	
2028	-1,253		-29	2,036		-205		44	2,761		-304		1,170	1,169				-59	1,837	
2038	-636		75	3,363		88		141	4,088		272		2,115	1,600				57	2,659	
2063	104		181	4,531		428		262	5,412		911		3,044	1,969				172	3,352	
2070	196		194	4,674		472		278	5,577		990		3,159	2,014				186	3,437	
Winter-run Chinook																				
2013	0		0	0		0		0	0		0		0	0		0		0	0	
2014	-716		-70	-57		-580		59	-107		-633		-21	-212		-976		-429	-210	
2015	-781		-139	14		-552		122	69		-643		-17	-115		-1,131		-532	-189	
2017	-887		-169	254		-554		252	352		-677		96	101		-1,386		-591	-175	
2018	-983		-172	412		-560		327	501		-705		153	202		-1,478		-586	-174	
2028	-1,251		54	2,036		-180		1,251	2,821		-277		1,190	2,453		-1,444		-102	-11	
2038	-628		645	3,369		121		1,808	4,172		309		2,152	3,967		-743		551	301	
2063	119		1,221	4,543		469		2,435	5,519		958		3,096	5,275		60		1,174	584	
2070	212		1,292	4,688		513		2,516	5,686		1,039		3,214	5,435		162		1,251	619	
Steelhead																				
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
2014	-689	0	-96	-250	-689	-444	0	68	-207	-444	-534	0	-32	-303	-534	-1,175		-595	-795	-1,175
2015	-799	0	-171	-235	-799	-389	0	168	-49	-389	-546	0	-6	-216	-546	-1,483		-746	-811	-1,483
2017	-987	0	-204	-120	-987	-393	0	348	213	-393	-610	0	141	-14	-610	-2,000		-860	-654	-2,000
2018	-1,162	0	-211	-40	-1,162	-406	0	450	360	-406	-662	0	212	90	-662	-2,195		-865	-521	-2,195
2028	-1,902	0	57	839	-1,902	286	0	1,747	2,202	286	49	0	1,626	1,919	49	-2,320		-195	782	-2,320
2038	-1,000	0	929	2,011	-1,000	868	0	2,540	3,260	868	1,011	0	2,923	3,224	1,011	-1,251		778	1,851	-1,251
2063	23	0	1,797	3,098	23	1,533	0	3,427	4,351	1,533	2,000	0	4,195	4,392	2,000	-102		1,721	2,811	-102
2070	151	0	1,904	3,231	151	1,618	0	3,540	4,489	1,618	2,123	0	4,354	4,537	2,123	40		1,838	2,930	40
Delta Smelt																				
2013	0				0	0	0	0		0	0	0	0		0	0	0	0		0
2014	0				0	0	51	49		0	0	51	49		0	0	-812	-752		0
2015	0				0	0	96	88		0	0	96	88		0	0	-904	-839		0
2017	0				0	0	255	232		0	0	255	233		0	0	-716	-635		0
2018	0				0	0	293	268		0	0	293	269		0	0	-478	-398		0
2028	0				0	0	675	877		0	0	676	879		0	0	1,440	1,485		0
2038	0				0	0	782	1,048		0	0	783	1,052		0	0	1,920	1,947		0
2063	0				0	0	862	1,178		0	0	865	1,181		0	0	2,280	2,292		0
2070	0				0	0	872	1,193		0	0	875	1,197		0	0	2,325	2,335		0
Green Sturgeon																				
2013			0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
2014			-368	0	-630	0		-517	0	-1,157	0	0	-517	0	-1,157	0	75	696	0	-625
2015			-66	0	-595	0		-380	0	-1,556	0	0	-380	0	-1,556	0	151	1,308	0	-676
2017			419	0	-564	0		-255	0	-2,285	0	-4	-255	0	-2,285	0	302	2,163	0	-790
2018			646	0	-557	0		-166	0	-2,740	0	-11	-166	0	-2,740	0	381	2,492	0	-830
2028			2,923	0	-575	0		1,574	0	-6,175	0	520	1,574	0	-6,175	0	753	3,847	0	-949
2038			3,582	0	-579	0		2,099	0	-7,055	0	693	2,099	0	-7,055	0	833	4,139	0	-973
2063			4,077	0	-582	0		2,492	0	-7,716	0	824	2,492	0	-7,716	0	893	4,355	0	-991
2070			4,139	0	-583	0		2,540	0	-7,797	0	840	2,540	0	-7,797	0	900	4,383	0	-992

- Not Analyzed
- >50% Greater
- >25%-50% Greater
- >10%-25% Greater
- 5%-10% Greater
- <5% Different
- 5%-10% Less
- >10%-25% Less
- >25%-50% Less
- >50% Less

Graphics ... 00627.08 (6-18-13) AB

Figure 11-6
Alternative 6 SAM results showing bank-line weighted relative response (feet) within all regions combined

The program-wide SAM results by species indicate initial negative responses for all salmonid life stages in all seasons over the modeled 50-year period. The initial habitat deficits are the result of riparian vegetation and IWM removal from the program sites during construction. On-site mitigation from IWM, installed to replace or exceed pre-project conditions, coupled with riparian vegetation growth, drives habitat recovery for the salmonid life stages to current conditions by Year 50 at the latest, except for adult migration in winter for fall-run Chinook salmon, which has negative values through Year 50 despite gradual improvements following the initial habitat deficits. Habitat responses are generally improved in winter and spring compared with summer and fall due to differences between proportions of installed IWM and available aquatic vegetation. During winter and spring, recovery from initial habitat deficits for all salmonid life stages is complete by Year 25 at the latest, and often much earlier.

Region 1b would experience the greatest negative impacts as a result of site conditions in combination with the bank protection measures applied to those sites (Appendix F, Figure F-22).

For delta smelt, the SAM results indicate initial reductions in habitat values for spawning, incubation, and juvenile rearing only in summer. These deficits are due to temporary increases of bank substrate size and reductions in instream and riparian habitat that are assumed to reduce the availability and suitability of habitat for spawning, incubation, and rearing. The reductions are driven by the results in Region 1b that persist through Year 50. As previously described, these life stages are sensitive to changes in bank slope, availability of floodplain, instream structure, and aquatic vegetation. The results in Region 1a are generally positive, with slight decreases in the summer. However, results in Region 1b indicate modest decreases that escalate and persist through Year 50. This is primarily the result of those sites within that region that are repaired with Bank Protection Measure 5, which utilizes a rock slope and revegetation. In those cases, adverse changes to instream structure and bank slope drive the decreased SAM values. While the revegetation in Bank Protection Measure 5 provides value to several target fish species, SAM does not derive benefits from overhead cover for the delta smelt fry and juvenile rearing life stages.

SAM results for green sturgeon adult residence indicate deficits in winter and spring. This is the result of SAM deriving negative results for the adult residence life stage resulting from the changes in slope, which are primarily associated with the bench designs of Bank Protection Measures 4a, 4b, and 4c,. While these changes in slope would occur, the proposed bank protection measures typically would not affect (e.g., change the slope of) the deeper parts of the channel that are utilized by adult green sturgeon.

The increase in bank substrate size and reduced shallow water habitat, instream structure, and shade, as well as, the potential loss of spawning habitat would result in a significant effect. Implementation of Mitigation Measures FISH-MM-2, FISH-MM-3, and VEG-MM-1 would reduce the effect on fish species in the area to a level that is less than significant.

Chapter 12
Wildlife

Introduction and Summary

This chapter describes the environmental setting associated with wildlife resources, the determination of effects, the environmental effects on wildlife resources that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- A California Natural Diversity Database (CNDDB) records search of the counties in the program area: Butte, Colusa, Glenn, Placer, Sacramento, Sutter, Solano, Yolo, Yuba, and Tehama Counties (California Department of Fish and Game 2009).
- A U.S. Fish and Wildlife Service (USWFS) list of endangered, threatened, and proposed species for the counties in the program area: Butte, Colusa, Glenn, Placer, Sacramento, Yolo, Sutter, Solano, Yuba, and Tehama (U.S. Fish and Wildlife Service 2009).
- Program area county general plans:
  - Butte County 2030 General Plan (Butte County 2010).
  - Colusa County Draft General Plan (Colusa County 2011).
  - Glenn County General Plan (Glenn County 1993).
  - Placer County General Plan (Placer County 1994).
  - Sacramento County 2030 General Plan (Sacramento County 2011).
  - Solano County General Plan (Solano County 2008).
  - Sutter County 2030 General Plan (Sutter County 2011) and Sutter County General Plan Update Technical Background Report (2008).
  - Tehama County General Plan (Tehama County 2009).
  - Yolo County General Plan (Yolo County 2009).
  - Yuba County General Plan (Yuba County 2011) and Yuba County General Plan Update Background Report (Yuba County 2008).
- Program area habitat conservation plans (HCPs) and Natural Community Conservation Plans (NCCPs):
  - Butte Regional Conservation Plan (in prep).
  - Natomas Basin HCP (City of Sacramento et al. 2003).
  - Yuba-Sutter HCP/NCCP (in prep).
  - Yolo Natural Heritage Program (in prep).
- American River Parkway Plan (Sacramento County 2008).

- Existing SRBPP program and project-level documents:
  - Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites: Sacramento River Bank Protection Project (U.S. Army Corps of Engineers 2009).
  - Final Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009: Sacramento River Bank Protection Project, Sacramento River and Tributaries, California (U.S. Army Corps of Engineers 2008).
  - Programmatic Biological Assessment for the Sacramento River Bank Protection Project Phase II, Final (Stillwater Sciences 2007)
  - Environmental Assessment/Initial Study for Five Critical Erosion Sites, River Miles 26.9 Left, 34.5 Right, 72.2 Right, 99.3 Right, and 123.5 Left Sacramento River Bank Protection Project, Draft (U.S. Army Corps of Engineers 2006a)
  - Environmental Assessment for levee repair of 14 Winter 2006 critical sites, Sacramento River Bank Protection Project, Final Report (U.S. Army Corps of Engineers 2006b)
  - Sacramento River Bank Protection Project, Erosion Management Report on Potential Impacts and Considerations for Bank Swallow and Associated Habitat (ICF International 2012)
- Other published and unpublished reports.
- ICF International file information.

Table 12-1 summarizes the effects on wildlife resulting from the implementation of the proposed program.

Table 12-1. Summary of Wildlife Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
Effect WILD-1: Permanent Loss of Riparian Habitat for Special-Status Wildlife Species Associated with Compliance with the Vegetation ETL	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Develop revegetation plan prior to removal of existing riparian vegetation. Plantings will be monitored over a minimum period of time, as determined by the appropriate state and federal agencies.
Effect WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities	VEG-MM-1	Same as above
	VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel	Prior to any construction work

Effect	Mitigation Measures	Implementation Period
	VEG-MM-8: Compensate for the Loss of Wetlands and Other Waters	Develop revegetation plan prior to removal of existing emergent wetland vegetation. Plantings will be monitored over a minimum period of time, as determined by the appropriate state and federal agencies.
	WILD-MM-1: Document Special-Status Wildlife Species and Their Habitats	As part of project-level environmental review
	WILD-MM-2: Avoid and Minimize Effects on Special-Status Wildlife Species by Redesigning the Action, Protecting Special-Status Wildlife Habitat, and Developing a Mitigation Monitoring Plan (If Necessary)	As part of project-level environmental review and during construction
	WILD-MM-3: Coordinate with Resource Agencies and Develop Appropriate Wildlife Compensation Plans for Species Listed under ESA and/or CESA	As part of project-level environmental review
Effect WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction	WILD-MM-4: Avoid or Minimize Construction-Related Effects on Nesting Birds	During construction
	WILD-MM-5: Conduct a Preconstruction Survey for Roosting Bats and Avoid or Mitigate Potential Impacts	Prior to any tree trimming and removal activities
Effect WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction	None required	Not applicable

Environmental Setting

The environmental setting for the proposed program is discussed in terms of the general program area, the four program regions (1a, 1b, 2, and 3), and the program study area. The program area and program regions are shown in Figure 2-1. The general program area consists of the watercourse reaches and associated levees expected to contain erosion protection sites as described in the Chapter 2, Project Description. The program area is further divided up into four program regions that serve to divide up the area into smaller assessment areas to more easily determine the types and magnitude of impacts resulting from the proposed program. The geographical extent of each program region is described in detail in Chapter 2. For the purposes of this chapter, the program study area contains the general program area plus a 0.5-mile buffer within which direct or indirect impacts on wildlife resources may occur. The study area is also discussed in terms of the four above-mentioned program regions.

Existing Conditions

Wildlife Habitat—Land Cover Type Associations

This section summarizes the land cover types identified in the program area and describes the relationship between land cover types and the wildlife habitats addressed in this analysis. Land cover types are described in detail in Chapter 10, Vegetation and Wetlands, and are discussed below as they pertain to wildlife habitat. Eight major land cover types were identified in the program area. These include natural and artificial land cover types.

Riparian Forest

Riparian forests are generally associated with rivers, low gradient streams, floodplains, and occasionally ponds and canals. Riparian forest communities are composed of a mature tree canopy dominated by valley oak (*Quercus lobata*) and Fremont cottonwood (*Populus fremontii*), and an understory consisting of a shrub layer of varying densities and an herbaceous ground layer.

Riparian forest communities provide wildlife with dispersal and migration corridors and foraging, cover, nesting, and breeding habitat (including shade and cover for aquatic species). Many species of birds, mammals, reptiles, and amphibians are known to use riparian communities and other woody vegetation communities located in close proximity to watercourses. Riparian trees provide suitable nesting and roosting habitat for a variety of raptors, egrets, herons, songbirds, and bats. Birds known to nest in these communities include red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), white-tailed kite (*Elanus leucurus*), Cooper's hawk (*Accipiter cooperii*), American kestrel (*Falco sparverius*), great blue heron (*Ardea herodias*), great egret (*Ardea alba*), green heron (*Butorides virescens*), belted kingfisher (Ceryle alcyon), Nuttall's woodpecker (*Picoides nuttallii*), western scrub-jay (*Aphelocoma californica*), California towhee (*Pipilo crissalis*), spotted towhee (*Pipilo maculates*), black phoebe (*Sayornis nigricans*), warbling vireo (*Vireo gilvus*), yellow-rumped warbler (*Dendroica coronata*), wrentit (*Chamaea fasciata*), and house wren (*Troglodytes aedon*). Bats species known to utilize riparian habitats for roosting in the program area include California myotis (*Myotis californicus*), Yuma myotis (*Myotis yumanensis*), hoary bat (*Lasiurus cinereus*), western red bat (*Lasiurus blossevillii*), and pallid bat (*Antrozous pallidus*). Other mammals species known to utilize these communities include beaver (*Castor canadensis*), Virginia opossum (*Didelphis virginiana*), striped skunk (*Mephitis mephitis*), black-tailed deer (*Odocoileus hemionus*), raccoon (*Procyon lotor*), and muskrat (*Ondatra zibethicus*). Reptiles, including common garter snake (*Thamnophis sirtalis*), western fence lizard (*Sceloporus occidentalis*), and western pond turtle (*Actinemys marmorata*), and amphibians, including Pacific tree frog (*Hylla regilla*), western toad (*Bufo boreas*), and bullfrog (*Rana catesbeiana*), are also associated with these communities. Additionally, valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) has potential to occur in areas where elderberry shrubs sized 1 inch or greater in diameter at ground level occur.

Riparian Scrub/Shrub

Riparian scrub/shrub plant communities primarily occur at the tow of levees and along the banks of rivers and streams and other drainages within the program area. These communities contain a variety of shrub and riparian tree species.

Riparian scrub/shrub provides nesting, cover, and foraging habitat for numerous bird species. Specifically California quail (*Callipepla californica*), yellow-rumped warbler, song sparrow (*Melospiza melodia*), spotted towhee, California towhee, wrentit, and bushtit (*Psaltriparus minimus*) are known to occur in these communities. Tricolored blackbird (*Agelaius tricolor*) may also nest in riparian scrub/shrub areas where blackberry or willow thickets are present. As with riparian forest, the functions and values of this habitat type for wildlife species are high.

Oak Woodland

Within the program area oak woodlands generally occur on the upper portion or landside of levees outside of riparian zones. These areas are dominated by mature trees, specifically valley oak, and provide similar wildlife habitat uses as riparian forests. Additionally acorn woodpecker (*Melanerpes formicivorus*) and northern flicker (*Colaptes auratus*) nest and forage in these habitats. Reptiles, including gopher snake (*Pituophis catenifer*) and California king snake (*Lampropeltis getulus californiae*), also frequent these habitats.

Ruderal Herbaceous Vegetation

Within the program area ruderal communities commonly occur along the mid- to upper-slope of levees and within levee crowns. These communities also occur on the waterside of the levee within gaps in the riparian forest canopy and riparian scrub/shrub communities. Despite a lack of native plant species richness and complexity, ruderal vegetation communities provide wildlife species with food resources (e.g., seeds from annual grasses and forbs) as well as cover and breeding opportunities. Birds known to forage in these communities include red-tailed hawk, American kestrel, burrowing owl (*Athene cunicularia*), northern mockingbird (*Mimus polyglottos*), western kingbird (*Tyrannus verticalis*), western meadowlark (*Sturnella neglecta*), Brewer's blackbird (*Euphagus cyanocephalus*), mourning dove (*Zenaida macroura*), rock pigeon (*Columba livia*), and American crow (*Corvus brachyrhynchos*). Western meadowlark and burrowing owl are also known to utilize these areas for nesting. Areas with nettle, thistle, or other shrubby upland vegetation may also support nesting of tricolored blackbirds. Mammals known to occupy these communities include black-tailed hare (*Lepus californicus*), California ground squirrel (*Spermophilus beecheyi*), pocket gopher (*Thomomys bottae*), deer mouse (*Peromyscus maniculatus*), and California meadow vole (*Microtus californicus*). Reptiles found in these communities include western fence lizard, gopher snake, California kingsnake, and western rattlesnake (*Crotalus viridis*).

Emergent Marsh

Emergent marsh is restricted to a relatively narrow saturation zone along toes of levee slopes and is characterized by the presence of hydrophytic (i.e., "water-loving") herbaceous plant species, such as cattails (*Typha* spp.), tules (*Schoenoplectus* spp.), rushes (*Juncus* spp.), and sedges (various genera), that are able to tolerate fluctuating water levels and persist in continuously saturated soils. Though most of these areas are likely relatively small in size, these areas provide cover and breeding habitat for bullfrog, tree frog, western toad, and common garter snake. Larger patches may also support nesting of marsh wren (*Cistothorus palustris*), wading birds such as Virginia rail (*Rallus limicola*), and songbirds, including red-winged blackbird (*Agelaius phoeniceus*), tricolored blackbird, and yellow-headed blackbird (*Xanthocephalus xanthocephalus*).

Agricultural Lands

Agricultural lands occur at the outer program area boundary on the landside of levees. These lands include orchards, vineyards, row and field crops, and pasturelands. Orchards and vineyards provide very little value for wildlife, though birds, such as red-shouldered hawk, American crow, yellow-billed magpie (*Pica nuttalli*), mourning dove, and rock pigeon, may nest and forage in these areas. Row and field crops provide foraging opportunities to a variety of raptors, including red-tailed hawk, Swainson's hawk, white-tailed kite, American kestrel, northern harrier, great-horned owl, barn owl and other migratory birds including western kingbird, Brewer's blackbird, American crow, yellow-billed magpie, European starling (*Sturnus vulgaris*), mourning dove, and rock pigeon, to name a few. Flooded agricultural fields provide foraging habitat for a variety of wading birds, including curlews and yellow-legs, and may support giant garter snake (*Thamnophis gigas*). Similar species are known to utilize pasturelands for foraging, and birds, such as burrowing owl, northern harrier, and western meadowlark, are also known to nest in these communities. Mammals known to occur in all types of agricultural lands include coyote (*Canis latrans*), grey fox (*Urocyon cinereoargenteus*), California ground squirrel, pocket gopher, deer mouse, and California meadow vole. Reptiles, such as western fence lizard, gopher snake, and California kingsnake, may also be found in association with these communities.

Barren

Barren areas within the program area generally include paved and dirt roads, dirt lots, revetment areas dominated by quarry stone or rock, and other areas that are devoid of vegetation, usually through vegetation management practices such as burning or discing (i.e., turning and loosening soil). Barren areas provide little value to wildlife; however, areas containing rock or wood piles or other debris piles may provide nesting opportunities for burrowing owls.

Open Water

Open water within the program area consists of rivers, creeks, sloughs, canals, and other unnamed drainages and ponds. Major water features within the program area are listed in Table 2-1 in Chapter 2, Project Description. Riparian forest and scrub/shrub vegetation communities are generally located adjacent to open water areas at the outboard toes of land slopes. Vegetation is not typically found directly within open water areas though instream woody material (IWM) is an important sub-community within many program area rivers and streams.

In addition to providing resources for fish, discussed in the Chapter 11, Fisheries and Aquatics, open water habitat provides foraging, cover, and reproductive sites for a variety of wildlife species. Open water areas provide essential foraging habitat for wading birds, including great blue heron, great egret, and snowy egret (*Egretta thula*); numerous waterfowl species, including mallard (*Anas platyrhynchos*), ruddy duck (*Oxyura jamaicensis*), Canada goose (*Branta canadensis*), and bufflehead (*Bucephala albeola*); other water birds, including eared grebe (*Podiceps nigricollis*), common merganser (*Mergus merganser*), cinnamon teal (*Anas cyanoptera*), double-crested cormorants (*Phalacrocorax auritus*), and American white pelicans (*Pelecanus erythrorhynchos*); and land birds, including osprey (*Pandion haliaetus*), black phoebe and belted kingfisher (*Megaceryle alcyon*). These areas also provide rearing habitat, escape cover, and foraging habitat for reptiles and amphibians, including western pond turtle, common garter snake, western aquatic garter snakes (*Thamnophis couchii*), giant garter snake, bullfrog, Pacific tree frog, and western toad. Several species of bats that occur in association with riparian forests forage for insects over open water. Other mammals, including black-tailed deer, raccoon, and striped skunk, utilize rivers and streams as water sources, and aquatic and semi-aquatic mammals that occur within open water habitats include beaver, river otter (*Lutra canadensis*), mink (*Mustela vison*), and muskrat.

Other Habitat Types

Vertical and Eroding Banks

Although not mapped as a "land cover type" in Chapter 10, vertical and eroding river banks provide nesting habitat for bank swallows (*Riparia riparia*). Within their breeding range, bank swallows will nest only where suitable habitat is present, usually at lower elevations. Bank swallows are colonial nesters that excavate burrows in a vertical bank, and construct a nest at the terminal end of the burrow. These vertical banks may be artificial or occur naturally. The burrows are normally found at least 3 feet high on steep-faced sand or gravel banks at river edges, quarries, or cliffs (Baicich 1997). It is estimated that the Sacramento River supports about 75% of the state's bank swallow population. These Sacramento River sites occur mainly between Redding and the Yolo Bypass in Yolo County (Garrison 1998).

Bank swallow habitat on the Sacramento and Feather Rivers is maintained through the fluvial processes of river meander, lateral migration, and bank erosion (Moffatt et al. 2005). These processes prepare nesting sites by exposing fresh vertical surfaces of river bank which include friable soil horizons suitable for colonization.

Special-Status Wildlife Species

Special-status wildlife species are defined as animals that are legally protected under the federal Endangered Species Act (ESA), the California Endangered Species Act (CESA), or other regulations, as well as species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status species are defined as those that meet any of the criteria listed below.

- Species that are listed or proposed for listing as threatened or endangered under the ESA (50 Code of Federal Regulations [CFR] Part 17.12 for listed plants, 50 CFR Part 17.11 for listed animals, and various notices in the Federal Register [FR] for proposed species).
- Species that are candidates for possible future listing as threatened or endangered under ESA (73 FR 75178, December 10, 2008).
- Species listed or proposed for listing by the State of California as threatened or endangered under the CESA (14 Code of California Regulations [CCR] Section 670.5).
- Species that meet the definitions of rare or endangered under CEQA (State CEQA Guidelines Section 15380).
- Animals listed as California species of special concern on the California Department of Fish and Wildlife's (DFW's) Special Animals List (California Department of Fish and Game 2009).
- Animals fully protected in California (Fish and Game Code Section 3511 [birds], Section 4700 [mammals], and Section 5050 [reptiles and amphibians]).

Based on the U.S. Fish and Wildlife (USFWS) (2009) list for the program area counties—Butte, Colusa, Glenn, Placer, Sacramento, Yolo, Sutter, Solano, Yuba, and Tehama—and a review of CNDDB (2009) for these counties, 49 special-status wildlife species were identified as occurring within a 10-mile radius of the program area (Table 12-1). Of these species, 30 have low to no potential to occur because the program area is outside the species' known range or suitable habitat is limited or absent. Three species are native vernal pool species—vernal pool fairy shrimp (*Branchinecta lynchi*), vernal pool tadpole shrimp (*Lepidurus packardi*), and California tiger salamander (*Ambystoma californiense*)—that are known to occur within the program study area (i.e., within 0.5 miles of the program area). These native vernal pool species are considered to have low to no potential to occur in the actual program area because, although habitats such as vernal pools may occur in areas adjacent to the levees, these habitats are absent along the SRBPP levees themselves. Furthermore, vernal pools are not expected to be subject to project impacts because construction, staging, and project access will be generally limited to the levees, established roadways, and previously disturbed areas, with the possible exception of sites where setback levees or adjacent levees are utilized.

The remaining 19 species are known to occur in the program study area and have moderate to high potential to occur in the program area based on the proximity of known occurrences and the presence of suitable habitat. These species are described in more detail below. Details of their potential to occur within a specified program area region are located in Table 12-2. Potential impacts on these species are described later in the chapter in the Effects and Mitigation Measures section.

Valley Elderberry Longhorn Beetle

Valley elderberry longhorn beetle is federally listed as threatened under ESA. The range of the beetle extends throughout the Central Valley of California and associated foothills, from the 3,000-foot-high contour in the east foothills, through the valley floor, to the watershed of the Central Valley in the west foothills (U.S. Fish and Wildlife Service 1999a). Elderberry shrubs (*Sambucus* spp.) are found in the remaining riparian forests and grasslands of the Central Valley and adjacent foothills. The beetle is often associated with various plant species, such as Freemont's cottonwood, California sycamore, willow, and oak (U.S. Fish and Wildlife Service 1999a).

Elderberry shrubs are the host plant for valley elderberry longhorn beetle and are a common component of the remaining riparian forests of the Central Valley. Elderberry shrubs are also common in upland habitats. Field surveys have found that adult valley elderberry longhorn beetle feed on elderberry foliage and perhaps flowers and are present from March through early June. It is during this time that the adults mate. The females lay their eggs, either singularly or in small clusters, in bark crevices or at the junction of stem and trunk or leaf petiole and stem. After hatching, a larva burrows into the stem of the elderberry where it creates a gallery, which it fills with grass and shredded wood. After the larva transforms into an adult beetle, it chews an exit hole and emerges from the elderberry. The life span of valley elderberry longhorn beetle ranges from 1 to 2 years. Studies of the spatial distribution of occupied shrubs suggest that the beetle is a poor disperser (U.S. Fish and Wildlife Service 1999a).

1 **Table 12-2. Special-Status Wildlife Species with Potential to Occur in Program Area**

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions: Region 1a	Region 1b	Region 2	Region 3
Invertebrates							
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T/--/--	Stream side habitats below 3,000 feet throughout the Central Valley.	Riparian and oak savanna habitats with elderberry shrubs; elderberries are the host plant.	High. Suitable habitat present; 26 occurrences within 10-mile radius and 21 occurrences within 0.5-mile radius.	High. Suitable habitat present; 27 occurrences within 10-mile radius and 19 occurrences within 0.5-mile radius.	High. Suitable habitat present; 49 occurrences within 10-mile radius and 36 occurrences within 0.5-mile radius.	High. Suitable habitat present; 41 occurrences within 10-mile radius and 26 occurrences within 0.5-mile radius.
Conservancy fairy shrimp *Branchinecta conservatio*	E/--/--	Disjunct occurrences in Solano, Merced, Tehama, Ventura, Butte, and Glenn Counties.	Large, deep vernal pools in annual grasslands.	None. Suitable habitat absent; 13 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Suitable habitat absent; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	None. Suitable habitat absent; no occurrences within 10-mile radius of region.	None. Suitable habitat absent; 7 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.
Vernal pool fairy shrimp *Branchinecta lynchi*	T/--/--	Central Valley, central and south Coast Ranges from Tehama County to Santa Barbara County; isolated populations also in Riverside County.	Common in vernal pools; also found in sandstone rock outcrop pools.	Low. Limited suitable habitat present; 56 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.	Low. Limited suitable habitat present; 65 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low. Limited suitable habitat present; 33 occurrences within 10-mile radius and 3 occurrences within 0.5-mile radius.	Low. Limited suitable habitat present; 23 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.
Vernal pool tadpole shrimp *Lepidurus packardi*	E/--/--	Shasta County south to Merced County.	Vernal pools and ephemeral stock ponds.	Low. Limited suitable habitat; 64 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.	Low. Suitable habitat absent; 69 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Limited suitable habitat; 33 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low. Limited suitable habitat; 30 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions: Region 1a	Region 1b	Region 2	Region 3
Delta green ground beetle *Elaphrus viridus*	T/--/--	Restricted to Olcott Lake and other vernal pools at Jepson Prairie Preserve, Solano County.	Sparsely vegetated edges of vernal lakes and pools; occurs up to 250 feet from pools.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.
Lange's metalmark butterfly *Apodemia mormo langei*	E/--/--	Once found throughout the Antioch Dunes; range now reduced to less than 10 acres of Antioch Dunes in Contra Costa County.	Limited to dense to moderately dense patches of food plant, wild buckwheat, in stabilized sand dunes.	None. Suitable habitat absent; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.
Amphibians							
California tiger salamander *Ambystoma californiense*	T/SSC/--	Central Valley, including Sierra Nevada foothills, up to approximately 1,000 feet, and coastal region from Butte County south to northeastern San Luis Obispo County.	Small ponds, lakes, or vernal pools in grasslands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy.	Low. Limited suitable habitat; 50 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None- Limited suitable habitat; no occurrences within 10-mile radius.	Low. Limited suitable habitat; 7 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low. Suitable habitat absent; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.
California red-legged frog *Rana aurora draytonii*	T/SSC/--	Found along the coast and coastal mountain ranges of California from Marin County to San Diego County and in the Sierra Nevada from Tehama County to Fresno County.	Permanent and semipermanent aquatic habitats, such as creeks and cold-water ponds, with emergent and submergent vegetation. May estivate in rodent burrows or cracks during dry periods.	Low. Limited suitable habitat; 16 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Reptiles							
Silvery legless lizard *Anniella pulchra pulchra*	--/SSC/--	Along the Coast, Transverse, and Peninsular Ranges from Contra Costa County to San Diego County with spotty occurrences in the San Joaquin Valley.	Habitats with loose soil for burrowing or thick duff or leaf litter; often forages in leaf litter at plant bases; may be found on beaches, sandy washes, and in woodland, chaparral, and riparian areas.	Low. Suitable habitat present; 9 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.
Alameda whipsnake *Masticophis lateralis euryxanthus*	T/T/--	Restricted to Alameda and Contra Costa Counties; fragmented into five disjunct populations throughout its range.	Valleys, foothills, and low mountains associated with northern coastal scrub or chaparral habitat; requires rock outcrops for cover and foraging.	Low. Limited suitable habitat; 15 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.
Giant garter snake *Thamnophis couchi gigas*	T/T/--	Central Valley from the vicinity of Burrel in Fresno County north to near Chico in Butte County; has been extirpated from areas south of Fresno.	Sloughs, canals, low gradient streams and freshwater marsh habitats where there is a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter.	High. Suitable habitat present; 131 occurrences within 10-mile radius and 61 occurrences within 0.5-mile radius.	High. Suitable habitat present; 106 occurrences within 10-mile radius and 40 occurrences within 0.5-mile radius.	High. Suitable habitat present; 141 occurrences within 10-mile radius and 69 occurrences within 0.5-mile radius.	High. Suitable habitat present; 39 occurrences within 10-mile radius and 21 occurrences within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions: Region 1a	Region 1b	Region 2	Region 3
Northwestern pond turtle *Emys marmorata marmorata*	--/SSC/--	Occurs from the Oregon border of Del Norte and Siskiyou Counties south along the coast to San Francisco Bay, inland through the Sacramento Valley, and on the western slope of Sierra Nevada.	Occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests.	High. Suitable habitat present; 16 occurrences within 10-mile radius and 4 occurrences within 0.5-mile radius.	High. Suitable habitat present; 17 occurrences within 10-mile radius and 3 occurrences within 0.5-mile radius.	High. Suitable habitat present; 14 occurrences within 10-mile radius and 4 occurrences within 0.5-mile radius.	High. Suitable habitat present; 6 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.
Birds							
Greater sandhill crane *Grus canadensis tabida*	--/T/--	Breeds in Siskiyou, Modoc, Lassen, Plumas, and Sierra Counties. Winters in the Central Valley, southern Imperial County, Lake Havasu National Wildlife Refuge, and the Colorado River Indian Reserve.	Summers in open terrain near shallow lakes or freshwater marshes. Winters in plains and valleys near bodies of fresh water.	Low. Limited suitable habitat; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.	None. Region outside of species' known range.	Low. Limited suitable habitat; 5 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.	Low. Limited suitable habitat; 2 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.
White-faced ibis *Plegadis chihi* (rookery site)	--/SSC/--	Both resident and winter populations on the Salton Sea and in isolated areas in Imperial, San Diego, Ventura, and Fresno Counties; breeds at Honey Lake, Lassen County, at Mendota Wildlife Management Area, Fresno County, and near Woodland, Yolo County.	Prefers freshwater marshes with tules, cattails, and rushes, but may nest in trees and forage in flooded agricultural fields, especially flooded rice fields.	Low. Limited suitable habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Limited suitable habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Limited suitable habitat; 3 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Limited suitable habitat; 2 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions: Region 1a	Region 1b	Region 2	Region 3
American peregrine falcon *Falco peregrinus anatum*	--/E/--	Permanent resident along the north and south Coast Ranges. May summer in the Cascade and Klamath Ranges and through the Sierra Nevada to Madera County. Winters in the Central Valley south through the Transverse and Peninsular Ranges and the plains east of the Cascade Range.	Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large prey populations.	Low. Foraging habitat only; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	None. Foraging habitat only; no occurrences within 10-mile radius.	Low. Foraging habitat only; 2 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Foraging habitat only; 2 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.
Prairie falcon *Falco mexicanus*	--/SSC/--	Found as permanent resident on the south Coast, Transverse, Peninsular, and northern Cascade Ranges, the southeastern deserts, Inyo-White Mountains, Modoc, Lassen, and Plumas Counties, and the foothills surrounding the Central Valley; winters in the Central Valley, along the coast from Santa Barbara County to San Diego County, and in Marin, Sonoma, Humboldt, Del Norte, and Inyo Counties.	Cliffs or escarpments for nesting; adjacent dry, open terrain or uplands, marshes, and seasonal marshes for foraging.	None. Foraging habitat only; no occurrences within 10-mile radius.	None. Foraging habitat only; no occurrences within 10-mile radius.	None. Foraging habitat only; no occurrences within 10-mile radius.	Low. Foraging habitat only; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Osprey *Pandion haliaetus*	--/SSC/--	Nests along the north coast from Marin County to Del Norte County, east through the Klamath and Cascade Ranges, and in the upper Sacramento Valley. Important inland breeding populations at Shasta Lake, Eagle Lake, and Lake Almanor and small numbers elsewhere south through the Sierra Nevada. Winters along the coast from San Mateo County to San Diego County.	Nests in snags, trees, or utility poles near the ocean, large lakes, or rivers with abundant fish populations.	Moderate. Suitable nesting habitat; no occurrences within 10-mile radius.	Moderate. Suitable nesting habitat; no occurrences within 10-mile radius.	High. Suitable nesting habitat; 7 occurrences within 10-mile radius and 6 occurrences within 0.5-mile radius.	High. Suitable nesting habitat; 16 occurrences within 10-mile radius and 8 occurrences within 0.5-mile radius.
Bald eagle *Haliaeetus leucocephalus*	--/E, FP/--	Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin. Reintroduced into central coast. Winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierra Nevada, and east of the Sierra Nevada south of Mono County.	In western North America, nests and roosts in coniferous forests within 1 mile of a lake, reservoir, stream, or the ocean.	None. No suitable nesting habitat; no occurrences within 10-mile radius.	None. No suitable nesting habitat; no occurrences within 10-mile radius.	Low. Limited suitable nesting habitat; 5 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Limited suitable nesting habitat; 2 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions: Region 1a	Region 1b	Region 2	Region 3
Golden eagle *Aquila chrysaetos*	PR/SSC, FP/--	Foothills and mountains throughout California. Uncommon nonbreeding visitor to lowlands such as the Central Valley.	Nest on cliffs and escarpments or in tall trees overlooking open country. Forages in annual grasslands, chaparral, and oak woodlands with plentiful medium and large-sized mammals.	None. Limited suitable nesting habitat; no occurrences within 10-mile radius.	Low. Limited suitable nesting habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	None. Limited suitable nesting habitat; no occurrences within 10-mile radius.	None. Limited suitable nesting habitat; no occurrences within 10-mile radius.
White-tailed kite *Elanus leucurus*	--/ FP/--	Lowland areas west of Sierra Nevada from the head of the Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border.	Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands for foraging.	Moderate. Suitable nesting habitat; 30 occurrences within 10-mile radius and 4 occurrences within 0.5-mile radius.	High. Suitable nesting habitat; 32 occurrences within 10-mile radius and 4 occurrences within 0.5-mile radius.	Moderate. Suitable nesting habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	High. Suitable nesting habitat; 2 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.
Northern harrier *Circus cyaneus*	--/SSC/--	Occurs throughout lowland California. Has been recorded in fall at high elevations.	Nests and forages in grasslands, meadows, marshes, and seasonal and agricultural wetlands.	Low to Moderate. Limited suitable nesting habitat; no occurrences within 10-mile radius.	Low to Moderate. Limited suitable nesting habitat; no occurrences within 10-mile radius.	Moderate. Limited suitable nesting habitat; 7 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Moderate. Limited suitable nesting habitat; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.
Northern goshawk *Accipiter gentilis*	--/SSC/--	Permanent resident in the Klamath and Cascade Ranges, in the north Coast Ranges from Del Norte County to Mendocino County, and in the Sierra Nevada south to Kern County. Winters in Modoc, Lassen, Mono, and northern Inyo Counties.	Nests and roosts in older stands of red fir, Jeffrey pine, Ponderosa pine, lodgepole pine, Douglas fir, and mixed conifer forests.	None. Region outside of species' known range.	None. Region outside of species' known range.	Low. Limited suitable habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Swainson's hawk *Buteo swainsoni*	--/T/--/--	Lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley. Highest nesting densities occur near Davis and Woodland, Yolo County.	Nests in oaks or cottonwoods in or near riparian habitats. Forages in grasslands, irrigated pastures, and grain fields.	High. Suitable nesting and foraging habitat; 946 occurrences within 10-mile radius and 279 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 494 occurrences within 10-mile radius and 204 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 387 occurrences within 10-mile radius and 181 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 70 occurrences within 10-mile radius and 35 occurrences within 0.5-mile radius.
Merlin *Falco columbarius*	--/SSC/--	Does not nest in California. Rare but widespread winter visitor to the Central Valley and coastal areas.	Forages along coastline in open grasslands, savannas, and woodlands. Often forages near lakes and other wetlands.	Low. Suitable foraging habitat only; 6 occurrences within 10-mile radius.	Low. Suitable foraging habitat only; 7 occurrences within 10-mile radius.	Low. Suitable foraging habitat only; 2 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low. Suitable foraging habitat only; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.
Western burrowing owl *Athene cunicularia hypugea*	--/SSC/--	Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas. Rare along south coast.	Level, open, dry, heavily grazed or low stature grassland or desert vegetation with available burrows.	High. Suitable nesting and foraging habitat; 192 occurrences within 10-mile radius and 12 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 100 occurrences within 10-mile radius and 10 occurrences within 0.5-mile radius.	Moderate. Suitable nesting and foraging habitat; 25 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 14 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Long-eared owl *Asio otus*	--/SSC/-- (nesting)	Permanent resident east of the Cascade Range from Placer County north to the Oregon border, east of the Sierra Nevada from Alpine County to Inyo County. Scattered breeding populations along the coast and in southeastern California. Winters throughout the Central Valley and southeastern California.	Nests in abandoned crow, hawk, or magpie nests, usually in dense riparian stands of willows, cottonwoods, live oaks, or conifers.	Low. Wintering habitat only; no occurrences within 10-mile radius.	Low. Wintering habitat only; no occurrences within 10-mile radius.	Low. Wintering habitat only; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Wintering habitat only; no occurrences within 10-mile radius.
Short-eared owl *Asio flammeus*	--/SSC/--	Permanent resident along the coast from Del Norte County to Monterey County although very rare in summer north of San Francisco Bay, in the Sierra Nevada north of Nevada County, in the plains east of the Cascades, and in Mono County; small, isolated populations.	Freshwater and salt marshes, lowland meadows, and irrigated alfalfa fields; needs dense tules or tall grass for nesting and daytime roosts.	Low. Limited suitable habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Limited suitable habitat; no occurrences within 10-mile radius.	Low. Limited suitable habitat; no occurrences within 10-mile radius.	Low. Limited suitable habitat; no occurrences within 10-mile radius.
California least tern (nesting colony) *Sterna antillarum browni*	E/E, FP/--	Nests on beaches along the San Francisco Bay and along the southern California coast from southern San Luis Obispo County south to San Diego County.	Nests on sandy, upper ocean beaches, and occasionally uses mudflats; forages on adjacent surf line, estuaries, or the open ocean.	None. Region outside of species' known range.	None. Region outside of species' known range.	Low. Limited suitable habitat; 2 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Purple martin *Progne subis*	--/SSC/--	Coastal mountains south to San Luis Obispo County, west slope of the Sierra Nevada, and northern Sierra and Cascade ranges. Absent from the Central Valley except in Sacramento. Isolated, local populations in southern California.	Nests in abandoned woodpecker holes in oaks, cottonwoods, and other deciduous trees in a variety of wooded and riparian habitats. Also nests in vertical drainage holes under elevated freeways and highway bridges.	Moderate. Suitable nesting and foraging habitat; 10 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Moderate. Suitable nesting and foraging habitat; 10 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.
Bank swallow *Riparia riparia*	--/T/--	Occurs along the Sacramento River from Tehama County to Sacramento County, along the Feather and lower American Rivers, in the Owens Valley; and in the plains east of the Cascade Range in Modoc, Lassen, and northern Siskiyou Counties. Small populations near the coast from San Francisco County to Monterey County.	Nests in bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam.	High. Suitable nesting and foraging habitat; 49 occurrences within 10-mile radius and 46 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 22 occurrences within 10-mile radius and 19 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 82 occurrences within 10-mile radius and 82 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 59 occurrences within 10-mile radius and 41 occurrences within 0.5-mile radius.
Loggerhead shrike *Lanius ludovicianus*	--/SSC/--	Resident and winter visitor in lowlands and foothills throughout California; rare on coastal slope north of Mendocino County, occurring only in winter.	Prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches.	Moderate. Suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	Low to Moderate. Suitable nesting and foraging habitat; no occurrences within 10-mile radius.	Moderate. Suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	Low to Moderate. Suitable nesting and foraging habitat; no occurrences within 10-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Tricolored blackbird *Agelaius tricolor*	--/SSC/--	Permanent resident in the Central Valley from Butte County to Kern County; breeds at scattered coastal locations from Marin County south to San Diego County and at scattered locations in Lake, Sonoma, and Solano Counties; rare nester in Siskiyou, Modoc, and Lassen Counties.	Nests in dense colonies in emergent marsh vegetation, such as tules and cattails, or upland sites with blackberries, nettles, thistles, and grain fields; habitat must be large enough to support 50 pairs; probably requires water at or near the nesting colony.	High. Suitable nesting and foraging habitat; 41 occurrences within 10-mile radius and 10 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 49 occurrences within 10-mile radius and 6 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 63 occurrences within 10-mile radius and 15 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 48 occurrences within 10-mile radius and 8 occurrences within 0.5-mile radius.
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	--/SSC/--	Locally numerous in the Klamath Basin, Modoc Plateau, Great Basin desert, and large mountain valleys in northeastern California; and in the San Joaquin Valley. Common breeders in the Colorado River valley, the Salton Sink, and the western Mojave desert; scarce in the Sacramento Valley and along the southern coast in Los Angeles, Riverside, and San Bernardino counties.	Nest in marshes with tall emergent vegetation, such as tules or cattails, generally in open areas and edges over relatively deep water. Breeding marshes often on edges of deep water bodies such as lakes, reservoirs, and or larger ponds.	Moderate. Limited suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.	High. Limited suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low to Moderate. Limited suitable nesting and foraging habitat; no occurrences within 10-mile radius.	Low to Moderate. Limited suitable nesting and foraging habitat; no occurrences within 10-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Western yellow-billed cuckoo *Coccyzus americanus*	C/E/--	Nests along the upper Sacramento, lower Feather, south fork of the Kern, Amargosa, Santa Ana, and Colorado Rivers.	Wide, dense riparian forests with a thick understory of willows for nesting; sites with a dominant cottonwood overstory are preferred for foraging; may avoid valley-oak riparian habitats where scrub jays are abundant.	High. Suitable nesting and foraging habitat; 8 occurrences within 10-mile radius and 8 occurrences within 0.5-mile radius.	Moderate. Suitable nesting and foraging habitat; 3 occurrences within 10-mile radius and 3 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 31 occurrences within 10-mile radius and 30 occurrences within 0.5-mile radius.	High. Suitable nesting and foraging habitat; 39 occurrences within 10-mile radius and 31 occurrences within 0.5-mile radius.
California black rail *Laterallus jamaicensis coturniculus*	--/T/--	Permanent resident in the San Francisco Bay and eastward through the Delta into Sacramento and San Joaquin Counties; small populations in Marin, Santa Cruz, San Luis Obispo, Orange, Riverside, and Imperial Counties.	Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations.	Low. Limited suitable nesting and foraging habitat; 23 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Limited suitable nesting and foraging habitat; no occurrences within 10-mile radius.	Low. Limited suitable nesting and foraging habitat; 35 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Limited suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	--/SSC/--	Found only in the San Francisco Bay Area in Marin, Napa, Sonoma, Solano, San Francisco, San Mateo, Santa Clara, and Alameda Counties.	Freshwater marshes in summer and salt or brackish marshes in fall and winter; requires tall grasses, tules, and willow thickets for nesting and cover.	Low. Limited suitable nesting habitat; 20 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Yellow warbler *Dendroica petechia brewsteri*	--/SSC/--	Nests over all of California except the Central Valley, the Mojave Desert region, and high altitudes along the eastern side of the Sierra Nevada. Winters along the Colorado River and in parts of Imperial and Riverside Counties. Two small permanent populations in San Diego and Santa Barbara Counties.	Nests in riparian areas dominated by willows, cottonwoods, sycamores, or alders or in mature chaparral; may also use oaks, conifers, and urban areas near stream courses.	None. Region outside of species' known range.	None. Region outside of species' known range.	Low. Suitable nesting and foraging habitat; 2 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.
Yellow-breasted chat *Icteria virens*	--/SSC/--	Nests locally in coastal mountains and Sierra Nevada foothills, east of the Cascades in northern California, along the Colorado river, and very locally inland in southern California.	Nests in dense riparian habitats dominated by willows, alders, Oregon ash, tall weeds, blackberry vines, and grapevines.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.	Low. Suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.
Grasshopper sparrow *Ammodramus savannarum*	--/SSC/--	Summer resident in the foothills of the Sierra Nevada and Coast Range from Mendocino and Trinity counties south to San Diego County.	Dry, dense grasslands with a variety of grasses and tall forbs and scattered shrubs.	Low. Suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	Low. Suitable nesting and foraging habitat; 1 occurrence within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Suisun song sparrow *Melospiza melodia maxillaris*	--/SSC/--	Restricted to the extreme western edge of the Delta, between the cities of Vallejo and Pittsburg near Suisun Bay.	Brackish and tidal marshes supporting cattails, tules, various sedges, and pickleweed.	Low. Limited suitable nesting and foraging habitat; 14 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.
Western snowy plover (inland populations) *Charadrius alexandrinus nivosus* (nesting)	--/SSC/--	Nests at inland lakes throughout northeastern, central, and southern California, including Mono Lake and Salton Sea.	Barren to sparsely vegetated ground at alkaline or saline lakes, reservoirs, ponds and riverine sand bars; also along sewage, salt-evaporation, and agricultural waste-water ponds.	Moderate. Possible suitable nesting and foraging habitat present; 2 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.	Moderate. Possible suitable nesting and foraging habitat present; 2 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.	Moderate. Possible suitable nesting and foraging habitat present; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low. Possible suitable nesting and foraging habitat present; no occurrences within 10-mile radius.
Mammals							
Western mastiff bat *Eumops perotis californicus*	--/SSC/ WBWG: high priority	Occurs along the western Sierra primarily at low to mid elevations and widely distributed throughout the southern coast ranges. Recent surveys have detected the species north to the Oregon border.	Found in a wide variety of habitats from desert scrub to montane conifer. Roosts and breeds in deep, narrow rock crevices, but may also use crevices in trees, buildings, and tunnels.	None. Region outside of species' known range.	None. Region outside of species' known range.	Moderate. Suitable roosting and foraging habitat; 6 occurrences within 10-mile radius and 4 occurrences within 0.5-mile radius.	Moderate. Suitable roosting and foraging habitat; 6 occurrences within 10-mile radius and 3 occurrences within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Hoary bat *Lasurius cinerius*	--/SSC/--	Occurs throughout California from sea level to 13,200 feet.	Primarily found in forested habitats. Also found in riparian areas and in park and garden settings in urban areas. Day roosts within foliage of trees.	Moderate. Suitable roosting and foraging habitat; 10 occurrences within 10-mile radius and 7 occurrences within 0.5-mile radius.	Moderate. Suitable roosting and foraging habitat; 5 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.	Moderate. Suitable roosting and foraging habitat; 11 occurrences within 10-mile radius and 9 occurrences within 0.5-mile radius.	Moderate. Suitable roosting and foraging habitat; 15 occurrences within 10-mile radius and 8 occurrences within 0.5-mile radius.
Pallid bat *Antrozous pallidus*	--/SSC/ WBWG: High priority	Occurs throughout California except the high Sierra from Shasta to Kern County and the northwest coast, primarily at lower and mid elevations.	Occurs in a variety of habitats from desert to coniferous forest. Most closely associated with oak, yellow pine, redwood, and giant sequoia habitats in northern California and oak woodland, grassland, and desert scrub in southern California. Relies heavily on trees for roosts.	Moderate. Suitable roosting and foraging habitat; 3 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Moderate. Suitable roosting and foraging habitat; 3 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Moderate. Suitable roosting and foraging habitat; 5 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	Moderate. Suitable roosting and foraging habitat; 6 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.
Pale Townsend's (=western) big-eared bat *Corynorhinus townsendii pallescens*	--/SSC/--	Klamath Mountains, Cascades, Sierra Nevada, Central Valley, Transverse and Peninsular Ranges, Great Basin, and the Mojave and Sonora Deserts.	Requires caves, tunnels, buildings or other human-made structures for roosting. Gleans insects from brush or trees and feeds along habitat edges.	None. Limited to no suitable roosting habitat, foraging habitat only; no occurrences within 10-mile radius.	None. Limited to no suitable roosting habitat, foraging habitat only; no occurrences within 10-mile radius.	None. Limited to no suitable roosting habitat, foraging habitat only; no occurrences within 10-mile radius.	Low. Limited to no suitable roosting habitat, foraging habitat only; 3 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
Western red bat *Lasiurus blossevillii*	--/SSC/ WBWG: High priority	Scattered throughout much of California at lower elevations.	Found primarily in riparian and wooded habitats. Occurs at least seasonally in urban areas. Day roosts in trees within the foliage. Found in fruit orchards and sycamore riparian habitats in the Central Valley.	High. Suitable roosting and foraging habitat; 13 occurrences within 10-mile radius and 7 occurrences within 0.5-mile radius.	High. Suitable roosting and foraging habitat; 4 occurrences within 10-mile radius and 2 occurrences within 0.5-mile radius.	High. Suitable roosting and foraging habitat; 8 occurrences within 10-mile radius and 8 occurrences within 0.5-mile radius.	High. Suitable roosting and foraging habitat; 13 occurrences within 10-mile radius and 7 occurrences within 0.5-mile radius.
Salt-marsh harvest mouse *Reithrodontomys Raviventris*	E/E, FP/--	San Francisco, San Pablo, and Suisun Bays; the Delta.	Salt marshes with a dense plant cover of pickle-weed and fat hen; adjacent to an upland site.	Low. Suitable habitat absent; 20 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.
American badger *Taxidea taxus*	--/SSC/--	In California, badgers occur throughout the state except in humid coastal forests of northwestern California in Del Norte and Humboldt Counties.	Occurs in a wide variety of open, arid habitats but is most commonly associated with grasslands, savannas, mountain meadows, and open areas of desert scrub; principal habitat requirements appear to be sufficient food (burrowing rodents), friable soils, and relatively open, uncultivated ground.	Low. Suitable habitat; 8 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low. Suitable habitat; 6 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low. Suitable habitat; 2 occurrences within 10-mile radius and 1 occurrence within 0.5-mile radius.	Low. Suitable habitat; 1 occurrence within 10-mile radius and 1 occurrence within 0.5-mile radius.

Common and Scientific Names	Status[a] Federal/ State/ Other	Geographic Distribution	Habitat Requirements	Potential Occurrence in Program Area Regions			
				Region 1a	Region 1b	Region 2	Region 3
San Joaquin kit fox *Vulpes macrotis mutica*	E/T/--	Principally occurs in the San Joaquin Valley and adjacent open foothills to the west; recent records from 17 counties extending from Kern County north to Contra Costa County.	Saltbush scrub, grassland, oak, savanna, and freshwater scrub.	Low. Limited suitable habitat; 4 occurrences within 10-mile radius and no occurrences within 0.5-mile radius.	None. Region outside of species' known range.	None. Region outside of species' known range.	None. Region outside of species' known range.

[a] Status explanations:

Federal

E = listed as endangered under the federal Endangered Species Act.

T = listed as threatened under the federal Endangered Species Act.

C = candidate species for which USFWS has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded.

-- = no listing.

State

E = listed as endangered under the California Endangered Species Act.

T = listed as threatened under the California Endangered Species Act.

FP = fully protected under the California Fish and Game Code.

SSC = species of special concern in California.

-- = no listing.

Western Bat Working Group (WBWG)

High priority = species are imperiled or at high risk of imperilment.

Based on CNDDB (2009) valley elderberry longhorn beetle is reported to occur within all four program study area regions. Riparian forest and scrub habitats, often containing elderberry shrubs, are prevalent throughout the four program regions. Valley elderberry longhorn beetle may occur within any of the four program regions wherever shrubs sized 1-inch diameter or more at ground level occur. Continuing maintenance of levees and canals is likely to account for less available habitat along the lower Sacramento River than along the upper Sacramento River (Talley et al. 2006). Levees along the lower Sacramento River limit restoration potential within Regions 1a and 1b of the program area. Additionally, creation of valley elderberry longhorn beetle habitat is constrained by concerns over allowing a federally listed species to inhabit SRFCP levees within these and other regions of the program area. Other factors negatively affecting valley elderberry longhorn beetle habitat are pesticide application and invasive species.

Approximately 50,000 acres of existing riparian habitat in the Central Valley, primarily in the Sacramento Valley, have been protected by federal, state, and local agencies, as well as private organizations. Within the program area, large parcels of suitable habitat for the valley elderberry longhorn beetle have been protected in the Sacramento River National Wildlife Refuge, along the American River Parkway, and in the lower Cosumnes River watershed, much of which is owned by The Nature Conservancy. Additionally, restoration of more than 5,000 acres of habitat has been initiated throughout the beetle's range (Talley et al. 2006).

Giant Garter Snake

The giant garter snake is listed as threatened under both ESA and CESA. The giant garter snake is the largest garter snake, reaching a maximum total length of at least 64 inches. Dorsal background coloration varies from brownish to olive with a checkered pattern of black spots, separated by a yellow dorsal stripe and two light colored lateral stripes (U.S. Fish and Wildlife Service 1999b).

Giant garter snakes are endemic to wetlands in the Sacramento and San Joaquin Valleys and inhabit marshes, sloughs, ponds, small lakes, low-gradient streams and other waterways, and agricultural wetlands such as irrigation and drainage canals and rice fields, as well as the adjacent uplands. There are four essential habitat components.

- Adequate water during the species' active season (early spring through mid-fall) to provide food and cover.
- Emergent herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season.
- Upland habitat with grassy banks and openings in waterside vegetation for basking.
- Higher-elevation uplands for cover and refuge from floodwaters during the dormant season in winter (U.S. Fish and Wildlife Service 1999b).

The giant garter snake is extremely aquatic and rarely found away from water. Giant garter snakes actively forage in the water and retreat to water to escape from predators and when disturbed. The predominant prey species include crayfish, carp (*Cyprinus carpio*), mosquitofish (*Gambusia affinis*), bullfrogs, and Pacific tree frogs. Giant garter snakes are typically absent from larger rivers and other water bodies that support introduced populations of large predatory fish and from wetlands with sand, gravel, or rock substrates. Riparian woodlands do not typically provide suitable habitat because of excessive shade, lack of basking sites, and absence of prey populations (U.S. Fish and Wildlife Service 1999b).

Giant garter snakes hibernate in small mammal burrows and other soil crevices located near aquatic habitat above prevailing flood levels throughout the winter months (November until early spring). They typically select burrows with sunny exposure along south- and west-facing slopes. Giant garter snakes also use burrows as refuge from extreme heat during their active period. The U.S. Geological Survey Biological Resources Division has documented giant garter snakes using burrows in summer as much as 165 feet away from the marsh edge. Overwintering giant garter snakes have been documented using burrows as far as 820 feet from the edge of marsh habitat (U.S. Fish and Wildlife Service 1999b).

Based on CNDDB (2009) giant garter snakes are reported to occur within all four program study area regions. Within the program area, suitable aquatic habitat for this species consists of emergent marshes, flooded agricultural fields, and slow-moving open water areas containing adjacent upland areas for winter hibernacula. Therefore, this species may occur in any of the four program regions where suitable habitat is present.

Activities in the program area that affect giant garter snakes are primarily related to flood control and agriculture. Flood control projects may result in mortality during construction and degradation of habitat. However, most flood control projects in the program area are conducted by federal, state, or local agencies and are conducted in compliance with Sections 7 or 10 of ESA. Consequently, the agencies are required to minimize potential take and restore affected habitat, resulting in mostly temporary impacts. Many agricultural activities that affect conditions for giant garter snakes are not subject to ESA consultation. Application of pesticides, rodent control, and discharge of nutrients can degrade both aquatic and upland habitat for the species (U.S. Fish and Wildlife Service 2006a).

Western Pond Turtle

The western pond turtle is a California species of special concern. The western pond turtle is the only abundant turtle native to California (California Department of Fish and Game 2005). It was historically found in most Pacific slope drainages between the Oregon and Mexican borders. It is still found in suitable habitats west of the Sierra-Cascade crest (Jennings and Hayes 1994).

Western pond turtles require some slow-water aquatic habitat and are uncommon in high-gradient streams (Jennings and Hayes 1994). The banks of inhabited waters usually have thick vegetation, but basking sites such as logs, rocks, or open banks must also be present (California Department of Fish and Game 2005). Depending on the latitude, elevation, and habitat type, the western pond turtle may become inactive over winter or remain active year-round. Nest sites are typically found on slopes that are unshaded and have high clay or silt composition (Jennings and Hayes 1994). Eggs are laid from March to August, depending on local conditions, and incubation lasts from 73 to 80 days. Western pond turtles are omnivorous and feed on aquatic plant material, aquatic invertebrates, fishes, frogs, and even carrion (California Department of Fish and Game 2005).

Based on CNDDB (2009) western pond turtles are reported to occur within all four program study area regions. Throughout the program area, open water and emergent marsh habitats provide potentially suitable aquatic habitat, while annual grassland, riparian forest, riparian scrub/shrub, and other upland areas adjacent to aquatic habitats provide potential winter hibernacula and nesting habitat. Therefore this species may occur in any of the four program regions where suitable habitat is present.

Swainson's Hawk

Swainson's hawks are protected under the Migratory Bird Treaty Act (MBTA) and are state-listed as threatened. Swainson's hawks inhabit grasslands, sage-steppe plains, and agricultural regions of western North America during the breeding season, and winter in grassland and agricultural regions from central Mexico to southern South America (England et al. 1997).

In California, the nesting distribution includes the Sacramento and San Joaquin Valleys, the Great Basin sage-steppe communities and associated agricultural valleys in extreme northeastern California, isolated valleys in the Sierra Nevada in Mono and Inyo Counties, and limited areas of the Mojave Desert region (California Department of Fish and Game 1994).

Since 1980, based on nesting records alone, populations in California appear relatively stable. However, continued agricultural conversion and practices, urban development, and water development have reduced available habitat for Swainson's hawks throughout their range in California; this habitat reduction could potentially result in a long-term declining trend. The status of populations, particularly with respect to juvenile survivorship, remains unclear.

In California, Swainson's hawk habitat generally consists of large, flat, open, undeveloped landscapes that include suitable grassland or agricultural foraging habitat and sparsely distributed trees for nesting (England et al. 1997). Foraging habitat includes open fields and pastures. Preferred foraging habitats for Swainson's hawk include alfalfa fields, fallow fields, low-growing row or field crops, rice fields during the nonflooded period, and cereal grain crops (California Department of Fish and Game 2000). Prey species include ground squirrels, California voles, pocket gophers, deer mice, reptiles, and insects (California Department of Fish and Game 2000; England et al. 1997).

Swainson's hawks usually nest in large native trees such as valley oak, cottonwood, and willows, although nonnative trees such as eucalyptus (*Eucalyptus* spp.) are occasionally used. Nests occur in riparian woodlands, roadside trees, trees along field borders, isolated trees and small groves, trees in windbreaks, and trees on the edges of remnant oak woodlands. In some locales, urban nest sites have been recorded. The breeding season is typically March to August (England et al. 1997).

CNDDB (2009) records indicate that Swainson's hawks are known to nest within all four program study area regions. Large trees located throughout the program area contain suitable nesting habitat, and row and field agricultural lands and grasslands contain suitable foraging habitat. Therefore this species may occur in any of the four program area regions where suitable habitat is present.

White-Tailed Kite

The white-tailed kite is protected under the MBTA and is a fully protected species under the California Fish and Game Code. White-tailed kites were threatened with extinction in North America during the early twentieth century. Populations recovered throughout its range in the United States from small populations that survived in California, Texas, and Florida. However, since the 1980s, many white-tailed kite populations have been declining, apparently because of loss of habitat and increased disturbance of nests (Dunk 1995).

The breeding season generally extends from early February through early August. White-tailed kites usually nest in large native trees, although nonnative trees also are occasionally used. Nest trees are generally at the edge of wooded habitat next to open fields. Large trees in areas that have been developed may also be used, although the trees need to be close to open fields for foraging (Dunk

1995). White-tailed kites feed primarily on small mammals including voles (*Microtus* spp.), pocket mice (*Perognathus* spp.), and harvest mice (*Reithrodontomys megalotis*).

CNDDB (2009) records indicate that white-tailed kites are known to nest within program study area regions 1a, 1b, and 3. Though not reported to nest in region 2, white-tailed kites are also likely to nest within this region due to the abundance of suitable nesting habitat and adjacent foraging habitat. Large trees located throughout the program study area provide suitable nesting habitat, and row and field agricultural lands and grasslands provide suitable foraging habitat. Therefore this species may occur in any of the four program area regions where suitable habitat is present.

Osprey

Osprey is designated as a California species of special concern. Osprey is considered to be widespread and increasing in the United States and Canada (Poole et al. 2002). Species is reported to breed south to north in California from Fresno to Siskiyou with single breeding occurrences in Orange and San Diego Counties (California Department of Fish and Game 2009). A majority of the North American population winters south of the United States in Central and South America (Poole et al. 2002).

Birds typically begin fall migrations in August and wander widely before beginning true migration returning to breeding areas late February through April (Poole et al. 2002). Breeding typically occurs from March to September (Zeiner et al. 1990a). Ospreys use large trees or snags for nesting and cover and use open, clear water (rivers, lakes, reservoirs, and bays) to forage for fish, though reptiles, amphibians and invertebrates may also serve as food sources (Zeiner et al. 1990a).

CNDDB (2009) records indicate that ospreys are known to nest within program study area Regions 2 and 3, mostly along the Sacramento River. Though osprey is not reported to nest within Regions 1a and 1b, these regions are within the expected range for this species and contain an abundance of river and stream systems capable of supporting this species. Throughout the program area, areas containing large trees adjacent to large rivers and streams are capable of supporting breeding and foraging of this species. Therefore, this species may occur in any of the four program area regions where suitable habitat is present.

Loggerhead Shrike

The loggerhead shrike (*Lanius ludovicianus*) is designated as a California species of special concern. Loggerhead shrikes are a widespread species in North America, occurring from the southern Canadian provinces across most of the United States into Mexico (Yosef 1996). In California, loggerhead shrikes occur in open habitats with scattered shrubs, trees, posts, fences, utility lines, and other perches. Habitats include valley foothill forests, pinyon-juniper, desert riparian, and Joshua tree habitats (California Department of Fish and Game 2005). Loggerhead shrikes are adaptable to urban environments as long as preferred habitat characteristics and abundant prey supplies are present (Yosef 1996).

The loggerhead shrike is a predatory songbird. As opportunistic predators, loggerhead shrikes feed on a wide variety of prey, including insects, small mammals and birds, reptiles, amphibians, and occasionally carrion. Prey is often impaled on sharp objects such as thorns and barbed wire fences (Yosef 1996). Nesting habitat includes densely foliaged shrubs and trees near open habitats (California Department of Fish and Game 2005).

CNDDB (2009) records do not indicate any loggerhead shrike occurrences within any of the four program study area regions though this species is known to occur within 10 miles of Regions 1a and 2. Due to the presence of grasslands within all program regions, loggerhead shrikes could occur in all regions where suitable habitat is present.

Tricolored Blackbird

The tricolored blackbird is a California species of special concern. Within California, active breeding colonies occur in 46 California counties with the largest colonies in the Central Valley. In the Central Valley, breeding extends east into the foothills of the Sierra Nevada. Historically, most California colonies have been located in the Sacramento and San Joaquin Valleys, but habitat loss has reduced breeding considerably in this area in recent years (Beedy and Hamilton 1999). Tricolored blackbirds have three basic requirements for selecting their breeding colonies: open accessible water; a protected nesting substrate, including either flooded vegetation or thorny/spiny vegetation; and a suitable foraging space providing adequate insect prey within a few miles of the nesting colony. They often change their nest locations from year to year. An increasing percentage of tricolored blackbirds are utilizing Himalayan blackberry as well as dairies for nesting habitat (Beedy and Hamilton 1999).

Suitable breeding habitats within the Central Valley have been found to include emergent marsh areas with tules or cattail and upland habitats consisting of thistle, nettle, blackberry, wheat, and other shrubby upland substrates (Meese 2006). Foraging habitats in all seasons include annual grasslands, wet and dry vernal pools and other seasonal wetlands, agricultural fields (e.g., large tracts of alfalfa with continuous mowing schedules and recently tilled fields), cattle feedlots, and dairies. Tricolored blackbirds also occasionally forage in riparian scrub habitats and along marsh borders. Weed-free row crops and intensively managed vineyards and orchards do not serve as regular forage sites (Beedy and Hamilton 1999).

CNDDB (2009) records indicate that tricolored blackbirds are known to nest within all four program study area regions. Throughout the program area, emergent marshes, riparian scrub, and grassland or ruderal areas containing dense forbs provide suitable nesting habitat and adjacent open grasslands and row and field crops contain suitable foraging habitat. Therefore, this species may occur in any of the four program regions where suitable habitat is present.

Yellow-Headed Blackbird

Yellow-headed blackbird is a California species of special concern. This species breeds in central California and is a year-round resident in southern California. Nests are built in emergent vegetation of deep-water palustrine wetlands. The species also constructs nests over deeper water, primarily in cattails, bulrushes, or reeds (*Phragmites* spp.), often in the same wetlands as nesting red-winged blackbirds. Yellow-headed blackbird forages within wetlands and surrounding grasslands, as well as open agricultural areas—harvested grain fields, plowed fields, meadows, and pastures—or savanna. The species is not known to inhabit the forest interior, but it may use forest edges for roosting, loafing, or foraging (Twedt and Richard 1995).

During the breeding season, yellow-headed blackbirds feed primarily on aquatic prey, feeding aquatic insects to nestlings. During the post-breeding season, the species is known to consume primarily cultivated grains and weed seeds, often foraging in large flocks (Twedt and Richard 1995).

CNDDB (2009) indicates an historic (1899) occurrence for this species that falls within program study area regions 1a and 1b. Though not known to occur within Regions 2 and 3 this species could occur in any of the four program study area regions where suitable habitat is present.

Western Yellow-Billed Cuckoo

Western yellow-billed cuckoo is a federal candidate species and is state-listed as endangered. Breeding occurs in temperate North America south to Mexico, and Greater Antilles, with wintering occurring primarily in South America east of the Andes. Within California species occurs at isolated sites in Sacramento Valley in northern California, and along the Kern and Colorado River systems in southern California (Hughes 1999).

Western yellow-billed cuckoos arrive on breeding grounds starting mid-to late May with fall departures for wintering grounds beginning in late August, with most birds gone by mid September. Birds generally prefer open woodland with clearings and low, dense, scrubby vegetation; often associated with watercourses. Most often found to occupy various woodlands, riparian forests and thickets along streams and marshes, and successional shrubland. Primarily feed on large insects including caterpillars, katydids, cicadas, grasshoppers, and crickets in open areas, woodlands, orchards, and areas adjacent to streams (Hughes 1999).

CNDDB (2009) records indicate that western yellow-billed cuckoos are known to nest within all four program study area regions. Throughout the program area, riparian forest and oak woodland areas contain suitable nesting and foraging habitat for this species. Therefore, this species may occur in any of the four program study area regions where suitable habitat is present.

Purple Martin

Purple martin is a California species of special concern. This species breeds locally along eastern slopes of Cascade Mountains of California south to extreme southwestern California. The species winters in South America in lowlands east of the Andes south to northern Argentina (rarely) and southern Brazil. Purple martin is the largest swallow in North America and among the largest in the world. These martins inhabit montane forest or Pacific lowlands, restricted to areas with dead snags containing woodpecker holes, generally patchy and local in occurrence. This species is reported to typically avoid deserts and grasslands (Brown 1997).

Purple martin is a diurnal, aerial feeder that feeds on insects at higher elevations than other swallows, sometimes up to 490 feet. Because of the height of foraging, individuals are rarely observed foraging, with the exception being late afternoons and near dusk when birds feed low and close to nest sites. The species presumably ranges over areas immediately surrounding nest site, although there is no information on typical travel distance while foraging. Cold, rainy weather in spring forces purple martins, especially migrants, to feed low over ponds and lakes, apparently in pursuit of aquatic insects along water surface (Brown 1997).

CNDDB (2009) indicates that purple martin is known to nest within program study area Regions 1a and 1b. Recorded occurrences within the study area include nesting colonies utilizing weep holes and other holes and crevices under freeway and other roadway overpasses. Within the program study area Regions 1a and 1b suitable nesting habitat for this species occurs in riparian forest and oak woodland areas. This species is presumed to be absent from the Central Valley with the exception of occurrences in the City of Sacramento; therefore, this species is expected to occur only in program area Regions 1a and 1b where suitable habitat is present.

Bank Swallow

The bank swallow (*Riparia riparia*) is a state-listed threatened species. Within California, bank swallow is a regular breeder from Monterey to San Francisco County and in northern California including Siskiyou, Shasta, and Lassen Counties and along Sacramento River from Shasta County south to Yolo County. Bank swallows nest in erodible soils on vertical or near-vertical banks and bluffs in lowland areas dominated by rivers, streams, lakes, and oceans. Based on the often ephemeral nature of nesting areas, bank swallow has low nest site fidelity. Foraging habitats surrounding nesting colony sites include wetlands, open water, grasslands, riparian forests, agricultural lands, shrublands, and occasionally upland woodlands (Garrison 1999).

Bank swallow is an aerial feeder from dawn to dusk that takes flying or jumping insects almost exclusively on the wing. The species is reported to occasionally eat terrestrial and aquatic insects or larvae and less often to consume vegetable matter. Bank swallow may feed on the ground where high concentrations of suitable insect prey are present (Garrison 1999).

CNDDB (2009) indicates that bank swallow is known to nest extensively within all four program study area regions along the banks of the Sacramento River, Feather River, American River, and Cache Creek. Throughout the program area suitable nesting habitat occurs along the above mentioned river systems. Table 12-3 highlights where bank swallow burrows have been surveyed to be on, directly adjacent to, or across the river from erosion sites currently being evaluated. The table is not a complete or exhaustive list of nesting locations, but demonstrates likely presence near the 106 sites over the past several years.

Western Snowy Plover (Inland Nesting Population)

Inland populations of western snowy plover are California species of special concern. Inland populations breed locally in southern central Oregon, Salton Sea, and eastern California, western and central Nevada, northwest Utah, and southern. Arizona. They also breed in southern Saskatchewan, southwestern Wyoming, southwestern Montana, central and eastern Colorado, New Mexico, central and southwestern Kansas, western Oklahoma, north-central Texas, and central Mexico (Page et al. 1995) and are reported to nest in central California in 1963 and 1970 in sewage ponds in Yolo County (California Department of Fish and Game 2009).

Inland populations breed on barren to sparsely vegetated ground at alkaline or saline lakes, reservoirs, ponds, on riverine sand bars, and at various types of ponds (sewage, salt-evaporation, and agricultural waste-water). Breeding varies depending on environmental conditions but generally occurs between March and mid-June. Inland birds feed on shores of lakes, reservoirs, ponds, braided river channels, and playas (mostly at seeps and along streams). Feeding typically occurs in shallow (1–2 cm deep) water or on wet mud or sand, on playas some foraging also occurs on dry flats where flies, beetles, moths, and caterpillars are available (Page et al. 1995).

CNDDB (2009) indicates that western snowy plover is known to nest within program study area regions 1a, 1b, and 2. Reported nesting occurrences within the program area consist of two breeding sites reported in 1963 and 1970 at sewage ponds in Yolo County. Suitable nesting habitat within the program area likely consists of riverine sand bars associated with program area rivers and streams, though the presence of this habitat has not been documented. Though only known to occur within program study area regions 1a, 1b, and 2 this species may occur in all program area regions where suitable habitat occurs.

Table 12-3. Summary of Existing Bank Swallow Burrows in Close Proximity to Erosion Sites being Evaluated

Representative Eroding Site	Average Number of Bank Swallow Burrows			
	River Mile	2008	2009	2010
Sacramento River				
SAC 172.0 L	172.5R	250	841	898
	172.4R	430		3
	172.1L		13	
	171.9L			32
	171.6L			170
	171.2R	290	172	
SAC 168.3L	168.3R	380	205	
	167.2L			115
SAC 163.0L	162.7L		106	
	162.6L	48		392
SAC 138.1L	137.8L			47
SAC 131.8L	130.9L		84	73
SAC 127.9R	128.3L		84	79
SAC 122.0R	121.4R		62	
SAC 116.5L	116.7L		179	426
	116.5L		11	
SAC 116.0L	116.7L		179	426
	116.5L		11	
SAC 86.9R	87.6L		126	162
	86.9L		Inactive*	
SAC 86.3L	86.9L		Inactive*	
Feather River				
FHR 5.5L	4.9-5.0R			56
FHR 5.0L	4.9-5.0R			56

Notes:

Highlight =	Bank swallow surveyed site that is on, directly adjacent to, or across the river from an erosion site.
Inactive* =	Site with old bank swallow burrows but no birds surveyed in 2008–2010.

Northern Harrier

The northern harrier is a California species of special concern and is protected under the MBTA and California Fish and Game Code Sections 3503 and 3503.5. The northern harrier is a medium-sized hawk raptor of upland grasslands and fresh- and saltwater marshes. In California, northern harriers are a permanent resident of the northeastern plateau, coastal areas, and Central Valley (Macwhirter and Bildstein 1996). Northern harriers breed in California in the Central Valley and Sierra Nevada (California Department of Fish and Game 2005).

Northern harriers frequent meadows, grasslands, desert sinks, open rangelands, and fresh- and saltwater emergent wetlands; they are seldom found associated with wooded habitats. Harriers feed mostly on voles and other small mammals, birds, frogs, small reptiles, crustaceans, insects, and rarely on fish (California Department of Fish and Game 2005). Harriers mostly nest in emergent wetland or along rivers or lakes, but may nest in grasslands, grain fields, or sagebrush flats several miles from water (Macwhirter and Bildstein 1996). The nest is built of a large mound of sticks on wet areas and a smaller cup of grasses on dry sites.

CNDDB (2009) indicates that northern harrier is known to nest within program study area Regions 2 and 3. Though not reported to nest within program study area Regions 1a and 1b these regions are within the expected range for this species and are likely to support this species. Throughout the program area, annual grassland, irrigated pasture, and emergent marsh may provide suitable nesting habitat and areas containing field crops and annual grasslands likely provide suitable foraging habitat. Therefore, this species may occur in any of the four program area regions where suitable habitat is present.

Western Burrowing Owl

Western burrowing owls are a California species of special concern and are protected under the MBTA. Western burrowing owls were formerly a common permanent resident throughout much of California, but population declines became noticeable by the 1940s and have continued to the present. Farming has taken a major toll on western burrowing owl populations and their habitat by destroying nesting burrows and exposing breeders and their young to the toxic effects of pesticides (Haug et al. 1993).

Western burrowing owls prefers open, dry, short grassland habitats with few trees and are often associated with burrowing mammals such as California ground squirrels. They occupy burrows, typically abandoned by ground squirrels or other burrowing mammals, but may also use artificial burrows such as abandoned pipes, culverts, and debris piles (California Department of Fish and Game 2012; Haug et al. 1993). Prey includes arthropods, amphibians, small reptiles, small mammals, and birds, particularly horned larks (Haug et al. 1993).

The breeding season usually extends from late February through August. Western burrowing owls often nest in roadside embankments, on levees, and along irrigation canals. This species is more diurnal than most owls and can often be observed during the day standing outside the entrance to its burrow (Haug et al. 1993).

CNDDB (2009) indicates nesting burrowing owl records within program study area Regions 1a, 1b, and 3. Though not reported to nest within region 2, burrowing owl is likely to also nest within this region due to the abundance of suitable nesting habitat. Throughout the program area, levees and grasslands provide suitable nesting habitat where ground squirrel burrows are present and open landscapes near suitable nesting habitat provide suitable foraging habitat. Therefore, this species may occur in any of the four program area regions where suitable habitat is present.

Western Mastiff Bat

Western mastiff bat (*Eumops perotis californicus*) is a California species of special concern. In California, it is an uncommon resident in southeastern San Joaquin Valley and coastal ranges from Monterey County southward to southern California (Zeiner et al. 1990b). It is also found sparsely in the Central Valley (CNDDB 2009) and occurs in open semi-arid to arid habitats such as conifer and deciduous woodlands, coastal scrub, grasslands, palm oases, chaparral, desert scrub, and urban. The species uses rock and tree crevices for cover and roosting. Mating occurs in March and young are born April through August or September. Western mastiff bat catches and feeds on insects in flight, mainly night-flying hymenopterous insects (Zeiner et al. 1990b).

CNDDB (2009) records indicate roosting of western mastiff bat in program study area Regions 2 and 3. Riparian forests and oak woodlands within these regions have potential to provide suitable roosting habitat for this species while adjacent open water areas provide suitable foraging opportunities. Though only reported in program study area Regions 2 and 3, this species may occur in any of the four program area regions where suitable habitat is present.

Hoary Bat

The hoary bat is a California species of special concern. Species is widespread in North America and can be found in any location within California though believed to have a patchy distribution in the southeastern deserts. Hoary bats are found primarily in forested habitats, including riparian forests, and may occur in park and garden settings in urban areas (Brown and Pierson 1996). Habitats that are suitable for providing maternity roosts include all woodlands that have medium- to large-sized trees with dense foliage. Females and young tend to roost at higher sites in trees (California Department of Fish and Game 2005). Mating occurs in autumn and is followed by delayed fertilization. Young are born in mid-May through early July. Species primarily feeds on moths and other flying insects (Zeiner 1990b).

CNDDB (2009) records indicate roosting of hoary bat in all four program study area regions. Riparian forests and oak woodlands throughout the program study area have potential to provide suitable roosting habitat for this species while adjacent open water areas provide suitable foraging opportunities. Therefore, this species may occur in any of the four program area regions where suitable habitat is present.

Western Red Bat

Western red bat is a California species of special concern that occurs throughout much of California at lower elevations. It is found primarily in riparian and wooded habitats but also occurs seasonally in urban areas (Brown and Pierson 1996). Western red bats roost in the foliage of trees that are often located on the edge of habitats adjacent to streams, fields, or urban areas. This species breeds in August and September, and young are born in May through July. Feed on a variety of insects including moths, crickets, beetles, and cicadas (Zeiner et al. 1990b).

CNDDB (2009) records indicate roosting of western red bat in all four program study area regions. Riparian forests and oak woodlands throughout the program study area have potential to provide suitable roosting habitat for this species while adjacent open water areas provide suitable foraging opportunities. Therefore, this species may occur in any of the four program area regions where suitable habitat is present.

Pallid Bat

The pallid bat is a California species of special concern. Species occurs throughout California with the exception of the high Sierra Nevada. Pallid bats are found in a variety of habitats but are particularly associated with oak woodlands, ponderosa pine, redwood, and sequoia habitats in central and northern California. Pallid bats have a high reliance on trees for day roosts (Brown and

Pierson 1996) and feed on a wide variety of insects and arachnids including beetles, orthopterans, homopterans, moths, spiders, scorpions, solpugids, and Jerusalem crickets (Zeiner et al. 1990b).

CNDDB (2009) records do not indicate any pallid bat observations within any of the four program study area regions. However, bat species are not readily incidentally observed and focused bat surveys are limited. Riparian forests and oak woodlands throughout the program area have potential to provide suitable roosting habitat for this species while adjacent open water areas provide suitable foraging opportunities. Therefore, all four regions are considered to have potential to contain this species.

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, and local environmental laws, regulations, and policies that apply to wildlife resources in the program area. Pertinent laws, regulations, and policies are listed below.

- Federal:
  - National Environmental Policy Act
  - Endangered Species Act
  - Migratory Bird Treaty Act
  - Fish and Wildlife Coordination Act
- State:
  - California Environmental Quality Act
  - California Endangered Species Act
  - California Fish and Game Code
- Local:
  - Butte County General Plan
  - Butte Regional Conservation Plan
  - Colusa County General Plan
  - Placer County General Plan
  - Sacramento County General Plan
  - American River Parkway Plan
  - Natomas Basin Habitat Conservation Plan
  - Solano County General Plan
  - Sutter County General Plan
  - Yuba-Sutter Habitat Conservation Plan/Natural Communities Conservation Plan
  - Tehama County General Plan
  - Yolo County General Plan

- ○ Yolo Natural Heritage Program
- ○ Yuba County General Plan

Determination of Effects

This section describes the methodology used to evaluate program-related effects on wildlife resources. The information used to determine the types of wildlife resources that could be impacted by program activities and the laws, regulations, and policies that apply to these resources is described above in the Introduction and Summary section of this chapter.

This section describes the type of analysis being conducted for the proposed program, the effects analysis assumptions, effect mechanisms, and significance thresholds used to conclude whether an effect would be significant.

Assessment Methods

Qualitative relationships between environmental conditions and life stage survival or wildlife resources are the basis of the effect assessment. Cause and effect relationships are identified for assessment species, including the relationship between environmental conditions and habitat, and the effects of changes in habitat on survival.

The effect analysis below is qualitative and programmatic and is not based on site-specific information. However, as applicable, each effect identifies how a particular effect may differ by program region based on available region-specific biological resource information. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant effects accompany each effect discussion. The mitigation measures described for potential effects on sensitive resources are currently being developed through formal or informal consultation or coordination with resource agencies (e.g., DFW and USFWS). A biological assessment has been prepared by the Corps and submitted to USFWS and NMFS to initiate formal programmatic Section 7 consultation. As part of subsequent, project-level environmental analysis of future program activities, project proponents will work with agencies as part of the environmental compliance process to determine specific mitigation and compensation requirements for effects on state- and federally listed and proposed species, other special-status species, critical habitat, and other habitats important to the survival and continued existence of these species. Additional mitigation and compensation measures may also be identified in future issued programmatic permits or approvals (e.g., programmatic Biological Opinion/Section 7 Incidental Take Statement or California Fish and Game Code Section 1602 Streambed Alteration Agreement).

Effect Assumptions

The following assumptions apply to program-related effects on wildlife.

- All program activities, including construction, associated equipment staging and access, and operations and maintenance activities, would be limited to the program area.
- Project-level analyses will be conducted for future SRBPP erosion repair projects to assess project-specific effects.

- All program activities will comply with the Engineering Technical Letter -2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures (Vegetation ETL). In other words, no vegetation would be permitted within the levee's operation and maintenance zone, which includes the levee itself and an area extending 15 feet from the landside and waterside toes. These areas, known as vegetation-free zones (VFZs), would be maintained free of woody vegetation in perpetuity.
- Operation or maintenance activities proposed under the program could result in similar direct and indirect effects on wildlife resources as compared with construction activities, though the magnitude of these effects is expected to be much lower than that of construction-related effects based on past experience demonstrating that minimal action is typically taken and, when it is taken, it involves relatively minor amounts of vegetation removal and/or rock placement.

Effect Mechanisms

The following program-related activities have been identified as activities that could result in direct and indirect effects on wildlife resources within the study area. These types of effects were used to assess effects on wildlife resources.

Direct Effects

- Clearing of vegetation (including trees), grading, excavating, trenching, placement of rock slope protection, and paving activities during construction.
- Loss of erosional processes that refresh and create bank swallow nesting habitat.
- Temporary stockpiling and sidecasting of soil, construction materials, or other construction wastes.
- Soil compaction, dust, and water runoff from the construction site.
- Short-term construction-related noise (from equipment).
- Degradation of water quality in drainages and wetlands, resulting from construction runoff containing petroleum products.

Indirect Effects

- Permanent alteration of light levels.
- Altering hydrology.
- Causing damage through toxicity associated with herbicides, insecticides, and rodenticides.
- Introducing pet and human disturbance (including trash dumping).
- Increasing habitat for native competitors or predators.
- Introducing invasive nonnative species.

Significance Criteria

For this analysis, an effect pertaining to wildlife resources was considered significant if it would result in any of the following environmental effects, which are based on the State CEQA Guidelines Appendix G (14 CCR 15000 et seq.).

- Have a substantial adverse effect, either directly or through habitat modification, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by DFW or the USFWS.
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.
- Conflict with the provisions of an adopted habitat conservation plan, natural communities conservation plan, or other approved local, regional, or state habitat conservation plan.
- Contribute to a substantial reduction or elimination of species diversity or abundance.

Local policies and ordinances that protect biological resources are addressed in Chapter 10, "Vegetation and Wetlands," and are not discussed further in this chapter. Activities associated with the proposed program may occur in the planning area of a number of HCPs or NCCPs, though at this time there is only one completed HCP: the Natomas Basin HCP. The Butte Regional Conservation Plan, Placer HCP, South Sacramento HCP, Yuba Sutter HCP/NCCP, and Yolo Natural Heritage Program are still under development. DWR is also preparing an HCP for some of its flood program. The intent of the proposed program is to protect the species covered by such plans through related compliance processes (e.g., Section 7 of the ESA, the Fish and Wildlife Coordination Act, and NEPA and CEQA mitigation measures). Regardless, completed HCPs and NCCPs will be consulted on a site-specific basis during project-level environmental review to ensure consistency. HCPs and NCCPs are not addressed further in this chapter.

Effects and Mitigation Measures

Alternative 1—No Action

The No Action Alternative is a continuation of the existing erosion deficiencies along proposed erosion repair areas within the program area. Current bank and levee maintenance activities, such as mowing and application of herbicides, would continue, and any effects from these activities would not be different from current (baseline) conditions. No direct or indirect construction-related effects on wildlife or its habitats would occur under this alternative.

Without erosion repairs, the risk of levee failure would continue. A catastrophic levee failure would result in flooding and inundation that could adversely affect wildlife and its upland or wetland habitats through physical displacement, mortality, or destruction of habitat. These adverse effects could be further exacerbated by emergency clean-up and repair activities that would be required in response to such an event, including the emergency placement of rock. Given the uncertainty of the occurrence or magnitude of such an event, potential effects on wildlife and its habitats cannot be quantified for this alternative but are expected to be potentially significant.

Alternative 2A—Low Maintenance

Effect WILD-1: Permanent Loss of Riparian Habitat for Special-Status Wildlife Species Associated with Compliance with the Vegetation ETL

All activities proposed under this alternative would comply with the Vegetation ETL without use of a variance, which requires that there be no woody vegetation on the crown, slopes and within 15 feet of the waterside and landside levee toes. These zones are to be maintained free of woody vegetation in perpetuity. Thus, the removal of a substantial amount of mature trees and vegetation from the levees of the SRFCP may be required.

Permanent loss of the woody vegetation in compliance with the Vegetation ETL would result in substantial adverse effects on special-status species dependent on riparian habitats. The full extent of this effect is dependent on what portions of the existing levee would be deemed as the levee prism by the Corps.

Riparian habitats, particularly in the Central Valley, provide essential nesting and cover habitat for numerous special-status wildlife species with known or potential occurrence in the study area, including valley elderberry longhorn beetle, western pond turtle, Swainson's hawk, white-tailed kite, osprey, western yellow-billed cuckoo, western mastiff bat, hoary bat, western red bat, and pallid bat. Valley elderberry longhorn beetles are dependent on riparian habitats containing elderberry shrubs, which are the host plant for valley elderberry longhorn beetle and are needed to complete the beetle's life cycle. Western pond turtle utilizes riparian vegetation for nesting and cover during the breeding season and for overwintering. Swainson's hawk, white tailed kite, osprey, and western yellow-billed cuckoo require mature trees for nesting. In the Central Valley, these trees are most prevalent within riparian habitats, particularly those along the Sacramento River. Though human-made structures are often used for day and night roosting by special-status bats, riparian habitats provide essential, natural roosting and cover habitat adjacent to important open water foraging areas.

Therefore, removal of woody riparian vegetation along levees in accordance with the Vegetation ETL would result in the loss of substantial key habitats needed to support special-status wildlife species in the study area. Because the riparian habitats within the study area are some of the most extensive in the Central Valley, the loss of these habitats would be a significant effect. Implementation of Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat would reduce the effect on species in the area over time. However, because mature riparian habitat cannot be replaced in the short term, this effect on the special-status wildlife species that depend on riparian habitats would remain significant and unavoidable.

Effect WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities

The program area has potential to support numerous special-status wildlife species. As described under the Special-Status Wildlife Species section, the study area contains documented occurrences of valley elderberry longhorn beetle, giant garter snake, western pond turtle, Swainson's hawk, white-tailed kite, osprey, northern harrier, western burrowing owl, tricolored blackbird, yellow-headed blackbird, western snowy plover (inland population), western yellow-billed cuckoo, purple martin, bank swallow, western mastiff bat, hoary bat, and western red bat. In addition, loggerhead shrike and pallid bat, both of which are also special-status wildlife species, have the potential to occur within the program area because of the presence of suitable habitat.

Construction within the program area could result in direct or indirect effects on special-status wildlife or their habitats, which are known to occur or could occur in the study area. Effects on special-status wildlife or its habitat could result in a substantial reduction in local population size, lowered reproductive success, or habitat fragmentation. Adverse effects on special-status wildlife associated with erosion repair projects would include the following effects.

- Direct mortality resulting from the movement of construction equipment and vehicles through the program area.
- Direct mortality from the collapse of burrows, resulting from soil compaction.
- Loss of breeding and foraging habitat resulting from the filling or removal of emergent marsh and open water areas.
- Loss of breeding, foraging, or refuge habitat resulting from the permanent removal of riparian vegetation, oak woodland, grasslands, and non-orchard agricultural lands.
- Loss of potential nesting habitat for bank swallows in the currently eroding banks.
- Abandoned eggs or young and subsequent nest failure for nesting special-status birds and other nonspecial-status migratory birds, including raptors, as a result of construction-related noise or close proximity to construction activity.
- Loss or disruption of migration corridors.

Depending on which special-status wildlife species (listed versus unlisted) are affected and the extent of the effect, these species could experience potentially significant effects. Implementation of Mitigation Measures WILD-MM-1 through WILD-MM-3 and VEG-MM-1, VEG-MM-4, and VEG-MM-8 would reduce effects. However, effects are likely to still be significant because of the presence of habitats within the program area that are regionally important to special-status species, particularly listed species. The final determination would need to be made at a project-level for individual sites in consultation with the applicable resource regulatory agency (USFWS and/or DFW). In addition, as discussed above under Effect WILD-1, the specific extent of actual vegetation removal as a result of compliance with the Vegetation ETL for levees would determine the severity of the effect on riparian-dependent wildlife species. Therefore, this effect is considered significant and unavoidable.

Mitigation Measure WILD-MM-1: Document Special-Status Wildlife Species and Their Habitats

As part of project-level environmental review, the program proponent will retain a qualified wildlife biologist to document the presence or absence of suitable habitat for special-status wildlife species. The results of this effort will allow the program proponent to implement Mitigation Measure WILD-MM-2: Avoid and Minimize Effects on Special-Status Wildlife Species by Redesigning the Action, Protecting Special-Status Wildlife Habitat, and Developing a Mitigation Monitoring Plan. The following steps will be implemented to document special-status wildlife species and their habitats:

- **Review Existing Information**. The wildlife biologist will review existing information to develop a list of special-status wildlife species that could occur in the project area. The following information will be reviewed as part of this process: the USFWS special-status species list for the action region; DFW's CNDDB; previously prepared environmental documents; city and county general plans; HCPs and NCCPs (if there are any adopted by the time the action is constructed); and the USFWS-issued biological opinion for the program.

- **Coordinate with State and Federal Agencies**. The wildlife biologist will coordinate with the appropriate agencies (DFW and USFWS) to discuss wildlife resource issues in the project area and determine the appropriate levels of survey necessary to document special-status wildlife species and their habitats.
- **Conduct Field Studies**. The wildlife biologist will evaluate existing habitat conditions and determine what levels of biological survey may be required. The type of survey required will depend on species richness, habitat type and quality, and the probability of special-status species occurring in a particular habitat type. Depending on the existing conditions in the project area and the proposed construction activity, one or a combination of the following levels of survey may be required.
  - **Habitat Assessment**. A habitat assessment determines whether suitable habitat is present. This type of assessment can be conducted at any time of year and is used to assess and characterize habitat conditions and to determine whether return surveys are necessary. If no suitable habitat is present, no additional surveys will be required. For bank swallow, it is especially important to analyze suitable habitat adjacent to the construction areas in addition to identifying existing habitat. There is uncertainty with regard to defining potential habitat, but identification should rely on physical parameters (e.g., soil type, erosiveness) or proximity to existing habitat.
  - **Conduct Species-Focused Surveys**. Species-focused surveys (or target species surveys) will be conducted if suitable habitat is present for special-status wildlife and it is necessary to determine the presence or absence of the species in the project area. The surveys will focus on special-status wildlife species that have the potential to occur in the region. The surveys will be conducted during a period when the target species are present and/or active.
  - **Conduct Protocol-Level Wildlife Surveys**. The project proponent will comply with protocols and guidelines issued by responsible agencies for certain special-status species. USFWS and DFW have issued survey protocols and guidelines for several special-status wildlife species that could occur in the study area, including valley elderberry longhorn beetle, Swainson's hawk, western burrowing owl, and giant garter snake. The protocols and guidelines may require that surveys be conducted during a particular time of year and/or time of day when the species is present and active. Many survey protocols require that only a USFWS- or DFW-approved biologist perform the surveys. The program proponent will coordinate with the appropriate state or federal agency biologist before initiation of protocol-level surveys to ensure that the survey results will be valid. Because some species can be difficult to detect or observe, multiple field techniques may be used during a survey period, and additional surveys may be required in subsequent seasons or years as outlined in the protocol or guidelines for each species.

Mitigation Measure WILD-MM-2: Avoid and Minimize Effects on Special-Status Wildlife Species by Redesigning the Action, Protecting Special-Status Wildlife Habitat, and Developing a Mitigation Monitoring Plan (If Necessary)

This mitigation measure focuses on avoiding and minimizing all direct and indirect effects on special-status wildlife species. The project proponent will implement the following measures to avoid and minimize effects on special-status wildlife species and their habitats.

- Redesign or modify the action to avoid direct and indirect effects on special-status wildlife species or their habitats, if feasible. In the case of the bank swallow, design measures to avoid active nests or suitable nesting habitat include utilizing setback or adjacent levees. Construction of setback or adjacent levees would not be feasible under Alternative 2A.
- Protect special-status wildlife species and their habitat near the project site by installing environmentally sensitive area fencing around habitat features, such as seasonal wetlands, elderberry shrubs, burrows, and nest trees. The environmentally sensitive area fencing or staking will be installed at a minimum distance from the edge of the resource as determined through coordination with state and federal agency biologists (DFW and USFWS). The location of the fencing will be marked in the field with stakes and flagging and shown on the construction drawings. The construction specifications will contain clear language that prohibits construction-related activities, vehicle operation, material and equipment storage, and other surface-disturbing activities within the fenced environmentally sensitive area. Construction-related activities will be restricted to the nonbreeding season for special-status wildlife species that could occur seasonally in the action area. Timing restrictions may vary depending on the species and could occur during any time of the year.
- Coordinate with the appropriate resource agencies to determine whether a construction monitoring plan for special-status wildlife species is necessary as part of the program. If a monitoring plan is required, it will be developed and implemented in coordination with appropriate agencies and will include all of the following information.
    - A description of each of the wildlife species and the suitable habitat for species that could occur at the action site.
    - Documentation of the locations of known occurrences of special-status wildlife species within 5 miles of the action site (e.g., CNDDB records search).
    - The location and size of no-disturbance zones in and adjacent to environmentally sensitive areas for wildlife.
    - Directions on the handling and relocating of special-status wildlife species found on the action site that are in immediate danger of being destroyed.
    - Notification and reporting requirements for special-status species that are identified on the action site.

Mitigation Measure WILD-MM-3: Coordinate with Resource Agencies and Develop Appropriate Wildlife Compensation Plans for Species Listed under ESA and/or CESA

If Mitigation Measure WILD-MM-2 is not feasible and site-specific construction activities would result in significant effects on wildlife species listed under ESA and/or CESA, a compensation plan will be developed in coordination with the appropriate resource agency, or agency-approved compensation guidelines will be followed to reduce the effect. Compensation guidelines have been identified for several special-status wildlife species, including valley elderberry longhorn beetle, Swainson's hawk, burrowing owl, and giant garter snake. The amount of compensation will vary depending on the amount and quality of habitat loss or degree of habitat disturbance anticipated. The compensation plan will be developed and implemented in coordination with the appropriate state or federal agency and will involve identifying an agency-approved mitigation bank or mitigation site (on or off site); transplanting (elderberry shrubs), re-creating (burrows), creating habitat restoration areas (i.e., removing rock to create bank swallow habitat); and/or preserving additional habitat for special-status wildlife species; monitoring the mitigation site; and funding the management of the mitigation site.

Effect WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction

The program area contains both natural and nonnatural habitats that support numerous common wildlife species. These species include a wide variety of terrestrial and aquatic invertebrates, birds and raptors, amphibians, reptiles, and mammals, some of which are listed in the Environmental Setting section.

Numerous common migratory bird species, including raptors, have potential to nest within the study area, including red-tailed hawk, red-shouldered hawk, great horned owl, American kestrel, and red-winged blackbird. Common bats, including California myotis, Yuma myotis, long-legged myotis (*Myotis volans*), long-eared myotis (*Myotis evotis*), and small-footed myotis *(Myotis subulatus*), also have potential to roost in trees and snags within the study area. Tree and shrub removal, other vegetation clearing, grading, or other construction activities could remove or cause abandonment of active bird nests or bat roosts. Within the program area, suitable nesting habitat for migratory birds occurs in riparian forest, riparian scrub, oak woodland, grassland, and pastureland. Similarly, riparian forests and oak woodland contain suitable bat roosting habitat. Effects on bird species protected under the MBTA and the California Fish and Game Code and effects on bat species protected by DFW are potentially significant. Implementation of Mitigation Measures WILD-MM-4 and WILD-MM-5 would reduce these effects to a level that is less than significant.

Effects on nonspecial-status wildlife species are considered less than significant because these species are widespread and abundant, the habitats they rely on exist well beyond the program area, and the potential losses of suitable habitat as a result of the proposed program in relation to the overall habitat available would be extremely small. As a result, the proposed program would not contribute to a substantial reduction of these nonspecial-status species' diversity or abundance.

Mitigation Measure WILD-MM-4: Avoid or Minimize Construction-Related Effects on Nesting Birds

To avoid removing or disturbing any active migratory bird and raptor nests, tree and shrub removal, other vegetation clearing, grading, and other construction activities will be conducted during the nonbreeding season (generally September 1 through February 14) or after a qualified biologist determines that fledglings have left an active nest.

If construction or tree-felling activities will be conducted during the breeding season (February 15 through August 31), a qualified biologist will be retained to conduct a breeding season survey for nesting birds for all trees, shrubs and ground-nesting habitat (and vertical banks along the project area for bank swallow) located within 500 feet (0. 5 mile for Swainson's hawk) of construction activities, including grading, vegetation removal, and excavation in borrow sites.

The following focused nesting surveys will take place prior to the start of construction and in the appropriate habitat to confirm the absence of nesting:

- Swainson's hawk surveys will be completed in accordance with the Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley (Swainson's Hawk Technical Advisory Committee 2000) with at least one survey being conducted no more than 48 hours prior to the start of construction to confirm the absence of nesting.
- Surveys for western burrowing owls will be conducted in accordance with DFW's 2012 Staff Report on Burrowing Owl Mitigation (2012 Staff Report) (California Department of Fish and Game 2012).
- Other bird nest surveys (within 500 feet of construction activities) can be conducted concurrent with Swainson's hawk surveys with at least one survey to be conducted no more than 48 hours from the initiation of project activities to confirm the absence of nesting.

If the biologist determines that the area surveyed does not contain any active nests, construction activities, including tree removal, can commence without any further mitigation for species. Construction activities will avoid bank swallow nesting areas. If avoidance of bank swallow nests is not possible, design measures to minimize impacts, including reducing the construction footprint to protect the upper bank from encroachment, will be considered. If nesting habitat is directly impacted, mitigation will include removal of existing rock at a former bank protection site, acquisition of a permanent easement, or participation in a conservation easement on an appropriate landform.

If active nests are found, the activities will not occur until nesting activities have ceased (i.e., after a qualified biologist determines that fledglings have left the nest) or DFW is contacted to determine an appropriate buffer area needed to protect nests from program activities.

If active bank swallow nests (nests containing eggs or young) are present within the construction easement, a no-disturbance buffer zone shall be established around the nest site. The width of the buffer zone shall be determined by a qualified biologist in coordination with DFW. No construction activities shall occur within the buffer zone. The buffer zone shall be maintained until the young have fledged (as determined by a qualified biologist). The buffer zone shall be delineated with exclusionary fencing/flagging and/or signage as appropriate. A qualified biologist shall monitor any active bank swallow nests that are located within the construction easement. The first monitoring event shall coincide with the initial implementation of construction activities and monitoring shall continue a minimum of once a week until the young have fledged. If the biologist determines that construction activities are disturbing the birds and nest failure is possible, DFW shall be immediately notified. Measures to avoid nest failure shall be implemented in coordination with DFW and may include halting some or all construction activities until the young have fledged. For any nest sites that require biological monitoring, a monitoring report shall be submitted to DFW within 2 weeks of termination of monitoring activities.

Mitigation Measure WILD-MM-5: Conduct a Preconstruction Survey for Roosting Bats and Avoid or Mitigate Potential Impacts

Bats are known to utilize tree cavities for breeding and wintering roosts and, therefore, conducting tree and shrub removal, other vegetation clearing, grading, and other construction activities outside of the breeding season may not avoid impacts on active roosts. Prior to any tree trimming and removal activities, a qualified biologist should conduct a preconstruction survey to determine whether bats are present. Trees within 100 feet of construction areas also should be surveyed to ensure that adjacent bat roosts are not disturbed. The survey should consist of a nighttime emergence survey of suitable trees for evidence (presence of guano or urine stains) of use by bats, and it should be conducted no more than 14 days prior to construction activities. If the biologist determines that the area surveyed does not contain any active roosts, activities may commence without any further mitigation. If active roosts are found, roosting structures should be retained, and the need for a construction buffer should be determined through consultation with DFW. If avoidance is not possible, DFW may require that bats be excluded from the habitat prior to start of the breeding and/or hibernation season. Compensatory mitigation of the loss of roosting habitat also should be determined through consultation with DFW but may include the construction and installation of suitable replacement habitat on site, such as bat houses.

Effect WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction

Within the program area, all watercourses and associated banks and levees are considered to act as movement corridors for wildlife. These areas provide important opportunities for food and cover for migrating or dispersing animals. During construction of erosion repair sites, movement through project sites would likely be temporarily impeded either by the placement of physical barriers (fencing) used to protect resources outside of the construction footprint or because of the presence of construction noise, which would be likely to discourage animals from entering the area. The program area is considered to contain numerous important movement corridors, particularly along the Sacramento, American, Feather, Yuba, and Bear Rivers, and disruption of these areas could adversely affect the ability of animals to move through these areas. However, it is assumed that construction at erosion repair sites within each region would be staggered based on varying schedule constraints at each site, and, thus, all sites would not be impassible at one time. Additionally, it is assumed that construction at each site would most often be completed within 1 year, thereby creating only a temporary barrier to movement within a specific localized area. The function of program area regions to act as movement corridors would, therefore, be disrupted temporarily during project construction within a localized area, but movement corridor function would be restored following the completion of program construction. Further, while vegetation loss will be substantial because of compliance with the Vegetation ETL as well as the varied vegetation loss from the different erosion treatments that could affect exposure rates, the losses would be intermittent as they are spread throughout the system and, therefore, would not substantially reduce the value of the area for wildlife movement. Therefore, this potential effect would be less than significant.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect WILD-1: Permanent Loss of Riparian Habitat for Special-Status Wildlife Species Associated with Compliance with the Vegetation ETL

All activities proposed under this alternative would comply with the Vegetation ETL without use of a variance. Under Alternative 3A, either a setback levee would be constructed some distance behind the existing levee or an adjacent levee embankment would be constructed toward the landside of the existing levee. In either case, the bank repair methods would shift the levee prism and VFZ landward. Within the VFZ of the new levee, the loss of vegetation would likely result in fewer effects on special-status wildlife species as compared with Alternative 2A, though the degree of the effect would depend upon the type and extent of vegetation present within the levee construction area. Construction of setback levees would create enlarged floodplains that would offer benefits to the giant garter snake, western pond turtle, various special-status birds and numerous other common wildlife species. However, there is substantial riparian habitat on the landside of existing levees that could be adversely affected by the construction of new levees or adjacent levees and result in significant effects. Implementation of Mitigation Measure VEG-MM-1 would ensure the eventual restoration of riparian habitats and reduce this effect to a less-than-significant level.

Effect WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities

As described under the Special-Status Wildlife Species section, the program area has potential to support numerous special-status wildlife species. Construction within the program area could result in direct or indirect effects on special-status wildlife or its habitats. Where setback levees are constructed, the loss of habitats (particularly woody habitats) would likely result in fewer effects on wildlife resources as compared with Alternative 2A, though the degree of the effect would depend upon the type and extent of habitats present within the setback levee construction area. The breaching or degrading of the existing levee and creation of an enlarged floodplain could benefit giant garter snake, western pond turtle, various special-status birds and numerous other common wildlife species (see beneficial effect, Effect-VEG-8) though the degree of the benefit will depend on the type of restoration that occurs within these new floodplain areas.

Where adjacent levees are constructed, woody vegetation along existing erosion repair site banks and levees would be retained along the waterside, though may be removed on the landside. Within the VFZ of the new levee, the loss of habitats (particularly woody habitats) would likely result in fewer effects on wildlife resources as compared with Alternative 2A, though the degree of the effect would depend upon the type and extent of habitats present within the adjacent levee construction area.

Though Alternative 3A would retain woody vegetation within the existing levee and potentially create an extended floodplain that could benefit special-status wildlife species, removal of woody vegetation and special-status species habitats due to the creation of a setback or adjacent levee could still result in significant effects because of the loss of habitat associated with the vegetation removal that would still need to occur. Implementation of Mitigation Measures WILD-MM-1 through WILD-MM-3 and VEG-MM-1, VEG-MM-4, and VEG-MM-8 would reduce effects to a less-than-significant level.

Effect WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction

This effect is similar to Effect WILD-3 as described under Alternative 2A, although the magnitude of Effect WILD-3 under Alternative 3A is expected to be substantially less than under Alternative 2A. Alternative 3A would retain woody vegetation on the existing levee and potentially create an extended floodplain that could benefit common wildlife species. However, effects on bird species protected under the MBTA and the California Fish and Game Code and effects on bat species protected by DFW are potentially significant because, as more fully described under Alternative 2A, tree and shrub removal, other vegetation clearing, grading, or other construction activities would still occur to some extent under Alternative 3A. These activities could remove or cause abandonment of active bird nests or bat roosts. Implementation of Mitigation Measures WILD-MM-4 and WILD-MM-5 would reduce these effects to a level that is less than significant.

Effects on common wildlife species not protected under the MBTA or California Fish and Game Code are considered less than significant because these species are widespread and abundant, the habitats they rely on exist well beyond the program area, and the potential losses of suitable habitat as a result of the proposed program in relation to the overall habitat available would be extremely small. As a result, the proposed program would not contribute to a substantial reduction for these nonspecial-status species' diversity or abundance.

Effect WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction

This effect is similar to Effect WILD-4 as described under Alternative 2A, although the magnitude of Effect WILD-4 under Alternative 3A is expected to be substantially less than under Alternative 2A because much less habitat would be removed or permanently altered as a result of implementing setback and adjacent levee designs under Alternative 3A. This effect is considered less than significant.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect WILD-1: Permanent Loss of Riparian Habitat for Special-Status Wildlife Species Associated with Compliance with the Vegetation ETL

All activities proposed under this alternative will comply with the Vegetation ETL without use of a variance. Under Alternative 4A, all of the available bank protection measures would be utilized to varying extents (see Table 2-2). The amount of woody riparian vegetation removed under Alternative 4A due to compliance with the Vegetation ETL would be less than under Alternative 2A but more than under Alternative 3A. The amount of vegetation to be removed under this alternative would be considered a significant effect on special-status wildlife species. Although implementation of Mitigation Measure VEG-MM-1 would ensure the eventual restoration of riparian habitats, short-term riparian habitat losses would still be considered a significant and unavoidable effect on special-status wildlife species.

Effect WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities

As described under the Special-Status Wildlife Species section, the program area has the potential to support numerous special-status wildlife species, and construction within the program area could result in direct or indirect effects on special-status wildlife species or their habitats.

The creation of riparian benches, setbacks or adjacent levees at a majority of sites under Alternative 4A would offset the loss of woody riparian habitat to a greater degree than under Alternative 2A because some of the replacement riparian habitat, required as compensation, would occur on-site as part of the project. Additionally, the creation of a wetland bench could offset effects on western pond turtle and giant garter snake by replacing aquatic cover and breeding habitat. Also, the placement of IWM along project site banks above the summer/fall waterline could offset effects on western pond turtle by replacing on-site nesting and cover habitat.

Where setback levees are constructed, the loss of habitats (particularly woody habitats) would likely result in fewer effects on wildlife resources as compared with Alternative 2A, though the degree of the effect would depend upon the type and extent of habitats present within the setback levee construction area. The breaching or degrading of the existing levee and creation of an enlarged floodplain could benefit giant garter snake, western pond turtle, and various special-status birds (see beneficial effect, Effect-VEG-8), though the degree of the benefit would depend on the type of restoration that occurs within these new floodplain areas.

Alternative 4A includes revegetation components that may offset effects to a greater degree than Alternative 2A would. However, Alternative 4A's effect on special-status wildlife species could still be potentially significant and unavoidable because mature riparian habitat, a key habitat for special-status species in the program area, cannot be replaced in the short term regardless of whether replacement is occurring on site or off site. Implementation of Mitigation Measures WILD-MM-1 through WILD-MM-3 and VEG-MM-1, VEG-MM-4, and VEG-MM-8 would reduce this effect, but it would remain significant and unavoidable. Additionally, though riparian vegetation would be replaced within waterside bank or levees areas outside of the Corps' designated VFZ, compensation of riparian vegetation removed from levees would likely still require off-site mitigation resulting in substantial reductions in riparian habitat within the program area. Though the creation of a wetland bench would offset impacts on special-status and common wildlife species dependent on wetland habitats, the benefit of this component would not offset the loss of riparian habitat and effects on riparian-dependent species associated with this alternative.

Effect WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction

This effect is similar to Effect WILD-3 as described under Alternative 2A. The magnitude of Effect WILD-3 under Alternative 4A is expected to be less than under Alternative 2A, but greater than under Alternative 3A. The creation of a wetland bench at many sites under Alternative 4A could offset effects on numerous common wildlife species by replacing aquatic cover and breeding habitat, and the creation of enlarged floodplains at certain sites would be beneficial as well. However, effects on bird species protected under the MBTA and the California Fish and Game Code and effects on bats protected by DFW are potentially significant. Implementation of Mitigation Measures WILD-MM-4 and WILD-MM-5 would reduce this effect to a level that is less than significant.

Effects on common wildlife species not protected by the MBTA and California Fish and Game Code are considered less than significant because these species are widespread and abundant, the habitats they rely on exist well beyond the program area, and the potential losses of suitable habitat as a result of the proposed program in relation to the overall habitat available would be extremely small. As a result, the proposed program would not contribute to a substantial reduction for these nonspecial-status species' diversity or abundance.

Effect WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction

This effect is similar to Effect WILD-4 as described under Alternative 2A. The magnitude of Effect WILD-3 under Alternative 4A is expected to be less than under Alternative 2A, but greater than under Alternative 3A. This effect is considered less than significant.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect WILD-1: Permanent Loss of Riparian Habitat for Special-Status Wildlife Species Associated with Compliance with the Vegetation ETL

All activities proposed under this alternative would comply with the Vegetation ETL without use of a variance. Under Alternative 5A, all of the available bank protection measures will be utilized to varying extents (see Table 2-2). The amount of woody riparian vegetation removed under Alternative 5A due to compliance with the Vegetation ETL would be similar to, though slightly less, than under Alternative 4A, and would be considered a significant effect on special-status wildlife species. Although implementation of Mitigation Measure VEG-MM-1 would ensure the eventual restoration of riparian habitats, short-term riparian habitat losses would still be considered a significant and unavoidable effect on special-status wildlife species.

Effect WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities

As described under the Special-Status Wildlife Species section, the program area has the potential to support numerous special-status wildlife species, and construction within the program area could result in direct or indirect effects on special-status wildlife or their habitats. Under Alternative 5A, all of the available bank protection measures would be utilized to varying extents (see Table 2-2). While Bank Protection Measure 1 would remove all vegetation within the project footprint, the remaining bank protection measures would retain vegetation to the extent feasible and consistent with the Vegetation ETL or create plantable space that would support riparian vegetation. As previously discussed in Chapter 2, the goal of Alternative 5A is to reach "environmental neutrality" with regard to existing habitat, with an emphasis on vegetation that is beneficial to target fish species, while at the same time protecting the bank from erosion. In this case, "environmental neutrality" refers specifically to fish habitat as evaluated using the Standard Assessment Methodology (SAM) (as described in Chapter 11, Fisheries and Aquatics) and riparian habitat. The program would be considered to meet environmental neutrality if the SAM values for the alternative are zero or greater (positive) and the amount of vegetation removed can be adequately replaced on-site or within other program sites within the same region (e.g., 1a, 1b, 2, or 3).

Where setback levees are constructed, the loss of habitats (particularly woody habitats) would likely result in fewer effects on wildlife resources as compared with Alternative 2A, though the degree of the effect would depend upon the type and extent of habitats present within the setback levee construction area. The breaching or degrading of the existing levee and creation of an enlarged floodplain could benefit giant garter snake, western pond turtle, and various special-status birds (see beneficial effect, Effect-VEG-8), though the degree of the benefit would depend on the type of restoration that occurs within these new floodplain areas.

Where adjacent levees are constructed, woody vegetation along existing erosion repair site banks and levees would be retained along the waterside, though may be removed on the landside. Within the VFZ of the new levee, the loss of habitats (particularly woody habitats) would likely result in fewer affects on wildlife resources as compared with Alternative 2A though the degree of the effect would depend upon the type and extent of habitats present within the adjacent levee construction area.

Setback levees were added into Regions 2 and 3 specifically under Alternative 5 to avoid bank swallow habitat. Eroding sites SAC 172.0L, SAC 168.3L, SAC 163.0L, SAC 138.1L, SAC 131.8L, and SAC 116.5L as listed in Table 2-2 were all redesigned with a setback levee to intentionally avoid known and/or suitable bank swallow nesting sites.

Alternative 5A includes revegetation components that may offset effects to a greater degree than Alternatives 2A or 4A would. However, Alternative 5A's effect on special-status wildlife species could still be significant because mature riparian habitat, a key habitat for special-status species in the program area, cannot be replaced in the short term regardless of whether replacement is occurring on site or off site. Implementation of Mitigation Measures WILD-MM-1 through WILD-MM-3 and VEG-MM-1, VEG-MM-4, and VEG-MM-8 would reduce this effect, but it would remain significant and unavoidable.

Effect WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction

This effect is similar to Effect WILD-3 as described under Alternative 4A. The magnitude of Effect WILD-3 under Alternative 5A is expected to be similar to that of Alternative 4A. This effect is considered significant, but implementation of Mitigation Measures WILD-MM-4 and WILD-MM-5 would reduce this effect to a level that is less than significant.

Effect WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction

This effect is similar to Effect WILD-4 as described under Alternative 2A. The magnitude of Effect WILD-3 under Alternative 5A is expected to be similar to that of Alternative 4A. This effect is considered less than significant.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect WILD-1 would not apply to Alternative 6A because this alternative would involve a variance from the Vegetation ETL, and removal of vegetation in the VFZ would not be implemented.

Effect WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities

Under Alternative 6A, all of the available bank protection measures would be utilized to varying extents, with the exception of adjacent levees (see Table 2-2). While Bank Protection Measure 1 would remove all vegetation within the project footprint, the remaining bank protection measures would retain vegetation to the extent feasible or create plantable space that would support riparian vegetation. As previously discussed in Chapter 2, the goal of Alternative 6 is to retain as much vegetation as feasible, through use of a variance from the Vegetation ETL.

In the situations where riparian benches are constructed under Alterative 6A, the types of effects on wildlife would be similar to that described above for Alterative 4A. The creation of riparian benches would offset the loss of woody riparian habitat because some riparian habitat required as compensation would be replaced on-site as part of the project. Additionally, the creation of a wetland bench could offset effects on western pond turtle and giant garter snake by replacing aquatic cover and breeding habitat. Also, the placement of IWM along project site banks above the summer/fall waterline could offset effects on western pond turtle by replacing on-site nesting and cover habitat.

In the limited situations where setback levees are constructed under Alternative 6A, the types of effects on wildlife would be similar to that described above for Alternative 3A. The breaching or degrading of the existing levee and creation of an enlarged floodplain could benefit giant garter snake, western pond turtle, and various special-status birds (see beneficial effect, Effect-VEG-8) though the degree of the benefit would depend on the type of restoration within these new floodplain areas.

Though Alternative 6A limits the removal of riparian vegetation, its effect on special-status wildlife species could still be significant because mature riparian habitat, a key habitat for special-status species in the program area, cannot be replaced in the short term regardless of whether replacement is occurring on site or off site. Implementation of Mitigation Measures WILD-MM-1 through WILD-MM-3 and VEG-MM-1, VEG-MM-4, and VEG-MM-8 would reduce this effect, but it would remain significant and unavoidable.

Effect WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction

This effect is similar to Effect WILD-3 as described under Alternative 4A. This effect is considered significant, but implementation of Mitigation Measures WILD-MM-4 and WILD-MM-5 would reduce this effect to a level that is less than significant.

Effect WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction

This effect is similar to Effect WILD-4 as described under Alternative 2A. The magnitude of Effect WILD-3 under Alternative 6A is expected to be similar to that of Alternative 4A. This effect is considered less than significant.

Chapter 13
Land Use and Agriculture

Introduction and Summary

This chapter describes the environmental setting associated with land use and agricultural resources, the determination of effects, the environmental effects on land use and agriculture that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed here.

- Program area county general plans.
- Program area habitat conservation plans (HCPs) and natural community conservation plans (NCCPs):
  - Butte Regional Conservation Program (in prep).
  - Yuba-Sutter HCP/NCCP (in prep).
  - Yolo Natural Heritage Program (in prep).
  - Natomas Basin HCP
- American River Parkway Plan (Sacramento County 2008).
- California Department of Conservation, Farmland Mapping and Monitoring Program Important Farmland maps (California Department of Conservation 2006).

Table 13-1 summarizes the effects on land use and agriculture resulting from the implementation of the proposed program.

Table 13-1. Summary of Land Use and Agriculture Effects and Mitigation

Effect	Mitigation Measure	Implementation Period
Effect LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor	None required	Not applicable
Effect LA-2: Conflicts with Local Land Use and Agriculture Policies	None required	Not applicable
Effect LA-3: Conversion of Important Farmland to Nonagricultural Uses	LA-MM-1: Evaluate the Potential for Direct Farmland Conversion at the Project Level and Avoid, Minimize, and Compensate for Loss of Farmland	During project-level environmental review

Environmental Setting

The environmental setting for the proposed program is discussed in terms of the general program area, the four program regions (1a, 1b, 2, and 3), and the program study area. The program area and regions are shown in Figure 1-1. The general program area is located along the Sacramento River and its tributaries and spans 10 counties, as described in the Existing Conditions section and in more detail in Chapter 2, Project Description. The program area is further divided into four regions, organized south to north by the location of the downstream terminus of each watercourse with the mainstem Sacramento River (Figure 2-1). The geographical extent of each program region is described in detail in Chapter 2, Project Description. For the purposes of this chapter, the program study area contains the general program area, where potential bank protection sites are located, plus a 0.5-mile buffer within which direct or indirect impacts on land use and agriculture may occur. The study area is also discussed in terms of the four program regions.

Existing Conditions

The land use context for the proposed program extends over 10 Sacramento Valley counties (Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba) and one San Joaquin–Sacramento Delta region county (Solano). While the proportion of land uses varies by county, the majority of the program area consists primarily of undeveloped agricultural fields and grassland, with large-scale urban development concentrated in a few centralized locations. Table 13-2 shows the percentage of land in different land use categories within each county in the program area.

Table 13-2. Land Use in Program Area Counties (Percentage of Total County Acreage*)

	County									
Land Use	Butte	Colusa	Glenn	Placer	Sacramento	Solano	Sutter	Tehama	Yolo	Yuba
Agriculture	51	59	69	26	62	64	80	71	75	64
Open Space	41	33	30	61	12	10	13	27	17	25
Water	1	0	0	6	1	9	0	0	1	2
Residential	5	3	0	4	17	4	2	1	3	4
Commercial	1	1	0	1	3	2	0	0	1	2
Industrial	1	4	0	1	3	3	4	0	1	3
Mixed Use	0	0	0	0	0	0	0	0	0	0
Planned Development	1	1	0	1	3	7	0	0	1	1
Undetermined	0	0	0	0	0	1	0	0	1	0
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

* The total sum of the percentages shown for each county may not add up to 100 percent due to decimal rounding.

Source: State of California 2009.

The program area also includes a substantial amount of open space, partially attributable to the presence of large public land holdings within the vicinity of the Sacramento River and its tributaries. Additionally, it is common for undeveloped grasslands that do not specifically carry an agricultural land use designation to be classified as open space.

For the purposes of this discussion, existing land uses are divided into three categories: general land uses, agricultural land uses, and general plan land use designations and zoning.

General Land Uses

Butte County

Butte County as a whole is generally rural with more than 92% of the county area designated for agricultural and open space uses. Butte County has five incorporated cities (Biggs, Chico, Gridley, Oroville, and Paradise), which range from small farming communities to medium-size urban centers. Numerous unincorporated communities are also located within Butte County, including Berry Creek, Brush Creek, Cherokee, Dayton, Durham, Feather Falls, Forbestown, Honcut, Magalia, Nelson, Palermo, and Paradise Pines.

Public lands in Butte County include those of the U.S. Forest Service (USFS), U.S. Bureau of Land Management (BLM), California Department of Fish and Wildlife (DFW), California State University, Chico (CSU Chico), and other public agencies such as school districts. Major public land holdings include the Plumas National Forest, Lassen National Forest, Gray Lodge Wildlife Area, Upper Butte Basin Wildlife Area, and Lake Oroville State Recreation Area. CSU Chico facilities include the 119-acre main campus in Chico and an 800-acre agricultural research center and teaching facility located south of the campus.

Colusa County

Colusa County as a whole is generally rural with more than 92% of the county area designated for agricultural and open space uses. Colusa County's two incorporated cities—Colusa and Williams—encompass about 1,300 acres. There are also five unincorporated communities in Colusa County: Maxwell, Princeton, Grimes, Stonyford, and College City.

About 45% of the county consists of forested rangeland, national wildlife refuges, and national forest lands. Much of the rangeland is owned by the BLM or the Bureau of Reclamation; national wildlife refuges and national forest lands in the county are owned by the U.S. Fish and Wildlife Service (USFWS) and the USFS, respectively. Major public land holdings include the Colusa, Delevan, and Sacramento National Wildlife Refuges, and Mendocino National Forest. The California State Parks also own the Colusa–Sacramento State Recreation Area near Colusa.

Glenn County

Glenn County as a whole is generally rural with more than 96% of the county area designated for agricultural and open space uses. Incorporated cities are Orland and Willows, and unincorporated communities include Bayliss, Glenn, Ord Bend, Capay, Codora, Four Corners, Artois, Hamilton City, Butte City, North Willows, Northeast Willows, and West Orland.

Public lands in Glenn County include those of the USFS or the USFWS, and various county and city parklands. Major public land holdings include Mendocino National Forest and Sacramento National Wildlife Refuge, of which approximately 8,555 acres are located in Glenn County.

Placer County

Approximately 87% of the land area in Placer County is composed of agricultural and open space uses. There are the six incorporated cities and towns in Placer County: Auburn, Colfax, Lincoln, Roseville, Rocklin, and Loomis. Unincorporated communities include Alpine Meadows, Alta, Applegate, Bowman, Carnelian Bay, Dutch Flat, Emigrant Gap, Foresthill, Gold Run, Granite Bay, Homewood, Iowa Hill, Kings Beach, Meadow Vista, Newcastle, Olympic Valley, Penryn, Sheridan, Tahoe City, Tahoe Vista, and Weimar.

Public lands in Placer County include those of the California State Parks and the USFS, and various county and city parklands and other public facilities. Major public land holdings include Auburn State Recreation Area, Folsom Lake State Recreation Area, and Tahoe National Forest.

Sacramento County

Urban development in Sacramento County is primarily clustered around the Sacramento metropolitan area in the northern half of the county and accounts for approximately 26% of the total land area, with the remaining areas composed of agricultural and open space uses. The county has seven incorporated cities: Sacramento, Citrus Heights, Elk Grove, Folsom, Galt, Isleton, and Rancho Cordova. Unincorporated communities include Antelope, Arden-Arcade, Carmichael, Del Paso Heights, Elverta, Fair Oaks, Florin, Foothill Farms, Gold River, Hagginwood, Herald, La Riviera, Laguna, Locke, Natomas, North Highlands, Orangevale, Parkway-South Sacramento, Rancho Murrieta, Rio Linda, Rosemont, Vineyard, Walnut Grove, and Wilton.

Public lands in Sacramento County include those of the USFWS and the California State Parks, and various county- and city-owned parklands and other public facilities. Major areas of public open space include Stone Creek National Wildlife Refuge; the Sacramento National Wildlife Refuge complex; Brannan Island State Recreation Area; Folsom Lake State Recreation Area; the Sacramento–San Joaquin Delta's islands and waterways; and the Cosumnes River floodplain. Within the urban area, the American River Parkway stands apart as the dominant open space feature. Other notable planned open spaces in the urban area include Dry Creek Parkway in Rio Linda and the buffer lands around the regional sewage treatment plant.

Solano County

Approximately 74% of the land area in Solano County is comprised of agricultural and open space uses. The county has seven incorporated cities: Benicia, Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo. Additionally, the county has five incorporated communities: Birds Landing, Collinsville, Cordelia, Elmira, Green Valley, and Bucktown.

Public lands in Solano County include those of the USFWS, California Department of Parks, DFW, and various county and city parklands and other public facilities. Major areas of public open space include the San Pablo Bay National Wildlife Refuge, Grizzly Island Wildlife Area, Benicia State Recreation Area, Lake Solano Park, Sandy Beach Park, Rockville Hills Regional Park, Suisun Marsh, Mare Island wetlands, and the open waters of San Pablo Bay.

Sutter County

Sutter County as a whole is generally rural with more than 93% of the County area designated for agricultural and open space uses. The county contains two incorporated cities—Yuba City and Live Oak—and several unincorporated rural communities, including Sutter, Robbins, Rio Oso, Nicolaus, Meridian, and East Nicolaus/Trowbridge.

Public Lands in Sutter County include those of USFWS and DFW, as well as municipal parklands within the jurisdiction of Yuba City and Live Oak. Three major water-related facilities are located on the Sutter Bypass and Feather Rivers, including the Sutter National Wildlife Area, which extends along the Sutter Bypass from Gilsizer Slough to the Wadsworth Canal; Fremont Weir Wildlife Area, located near the confluence of Sutter Bypass and the Sacramento River; and the Nelson Slough Unit of the Feather River Wildlife Area, located near the confluence of the Feather River and the Sutter Bypass. Several municipal parks or recreation areas are also located adjacent to the Feather River, including Boyd's Pump, Live Oak Park and Recreation Area, Shanghai Bend, and Yuba City Boat Ramp and Mosquito Beach within Yuba City.

Tehama County

Tehama County is largely rural in nature with isolated pockets of population primarily concentrated near the incorporated cities, and/or along the major transportation corridors. Agricultural and open space uses comprise approximately 98% of the total land area in the county. The county has three incorporated cities—Corning, Red Bluff, and Tehama—and 11 unincorporated communities: Dairyville, Flournoy, Gerber, Los Molinos, Manton, Mill Creek, Mineral, Paskenta, Paynes Creek, Proberta, and Vina.

The largest nonjurisdictional land holdings within Tehama County are managed by the USFS, BLM, NPS, U.S. Army Corps of Engineers (Corps), U.S. Bureau of Indian Affairs, and California State Parks. With respect to national parks and forests, major land areas include Mendocino National Forest, Lassen Volcanic National Park, Lassen National Forest, and Shasta-Trinity National Forest. BLM lands lie along the Sacramento River within Tehama County, including Foster Island, Todd Island, Iron Canyon, Bald Hill, Paynes Creek, Perry Rifle, Massacre Flat, Inks Creek, and Jelly's Ferry Area. Other major areas of public open space include Black Butte Lake Recreation Area, Woodson Bridge State Recreation Area, and tribal trust lands near the City of Corning that are associated with the Paskenta Band of Nomlaki Indians.

Yolo County

Yolo County as a whole is generally rural with more than 92% of the County area designated for agricultural and open space uses. Four incorporated cities are located in the County: Davis, West Sacramento, Winters, and Woodland. The total incorporated area of the County accounts for 32,325 acres, which is approximately 5% of county. The unincorporated county consists of 11 towns: Capay, Guinda, Rumsey, Clarksburg, Dunnigan, Esparto, Knights Landing, Madison, Monument Hills, Yolo, and Zamora.

Public lands in Yolo County include those of BLM, U.S. Bureau of Indian Affairs, DFW, and University of California-Davis, as well as Yolo County park. Major public land holdings include the Cache Creek Natural Area/Camp Haswell Park; Yolo Bypass, Sacramento Bypass, and Fremont Weir Wildlife Areas, and various tribal trust lands associated with the Wintun Indian Tribe. Among county parks, Elkhorn Regional Park and Boat Launch, which is located adjacent to the Sacramento River and north of West Sacramento, comprises the largest regional park in the vicinity of the program area.

Yuba County

Approximately 74% of the land area in Yuba County is composed of agricultural and open space uses. The county has two incorporated cities: Marysville and Wheatland. Unincorporated communities include Arboga, Browns Valley, Brownsville, Camptonville, Challenge, Dobbins, French Corral, Hallwood, Hammonton, La Porte, Loma Rica, Olivehurst, Oregon House, Rackerby, Renaissance, Smartville, Strawberry Valley, and Woodleaf.

Public lands in Yuba County include those of the USFS, and Yuba County Water Agency, and various county and city parklands and other public facilities. Major areas of public open space include Tahoe National Forest, Collins Lake, and New Bullards Bar Reservoir.

Agricultural Land Uses

Fertile soils, a long growing season, and the reliable availability of irrigation water in the Sacramento Valley and Delta region provide a favorable combination of conditions that support a wide variety of crops. According to county-level statistics obtained by the California Department of Food and Agriculture in 2007, rice, nuts, tomato processing, and dairy were the leading commodities in terms of the gross value of production in the Sacramento Valley counties (California Department of Food and Agriculture 2009).

Important Farmland

Potential bank protection sites in the program area are flanked by irrigated and nonirrigated farmland intermixed with scattered areas classified as *Other Land* and *Urban* and *Built up Land* under the Department of Conservation's Farmland Mapping and Monitoring Program (FMMP). Acreages of Important Farmland by county are presented in Table 13-3. Brief descriptions of important farmland within each county and in the vicinity of the program area are included below.

Table 13-3. Important Farmland Acreage in Program Area Counties, 2006

	Irrigated Farmland			Nonirrigated Farmland	
County	Prime	Statewide	Unique	Local	Grazing Land
Butte	196,219	21,604	24,235	0	407,678
Colusa	200,182	2,170	123,318	232,921	9,030
Glenn	161,685	87,867	17,469	80,290	229,191
Placer	8,525	5,020	22,792	101,847	28,692
Sacramento	106,667	51,217	15,268	41,961	156,977
Solano	139,536	7,164	11,036	0	202,826
Sutter	165,817	107,194	19,245	0	51,516
Tehama	63,707	17,284	18,085	132,437	1,550,095
Yolo	257,893	16,989	50,197	65,173	150,339
Yuba	41,993	11,019	32,372	0	142,729

Source: California Department of Conservation 2006.

Butte County

Of the 242,058 acres of Important Farmland inventoried in Butte County in 2006, 196,219 were designated Prime Farmland, 21,604 acres were designated Farmland of State Importance, and 24,235 were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is concentrated in the western half of the county, including in areas located immediately adjacent to potential bank protection sites along the Cherokee Canal and Butte Creek.

Colusa County

A total of 558,591 acres of Important Farmland were inventoried in Colusa County in 2006, of which 200,182 were designated Prime Farmland, 2,170 acres were designated Farmland of State Importance, and 123,318 acres were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is concentrated in the eastern portion of the county, including in areas located immediately adjacent to potential bank protection sites along the Colusa Drain and Sacramento River.

Glenn County

The total amount of Important Farmland inventoried in Glenn County in 2006 was 347,311 acres, of which 161,685 were designated Prime Farmland, 87,867 acres were designated Farmland of State Importance, and 17,469 acres were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is primarily found in the eastern portion of the county, including in areas located immediately adjacent to the bank protection sites along the Sacramento River.

Placer County

In 2006, the Department of Conservation inventoried 138,184 acres of Important Farmland in Placer County, of which 8,525 acres were designated Prime Farmland, 5,020 acres were designated Farmland of State Importance, and 22,792 were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is concentrated in the western area of the county, including in areas located immediately adjacent to potential bank protection sites along Bear River, Coon Creek, and the Natomas Cross Canal.

Sacramento County

A total of 215,113 acres of Important Farmland were inventoried in Sacramento County in 2006, of which 106,667 acres were designated Prime Farmland, 51,217 acres were designated Farmland of State Importance, and 15,268 acres were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is concentrated in the northwestern, central, and southwestern portion of the county, including in areas located immediately adjacent to the bank protection sites along the Sacramento River and the Delta.

Solano County

Important Farmland inventoried in Solano County in 2006 totaled 157,736 acres. Of this, 139,536 acres were designated Prime Farmland, 7,164 acres were designated Farmland of State Importance, and 11,036 acres were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is concentrated in the northern portion of the county, including in areas located immediately adjacent to potential bank protection sites along Putah Creek, Ulatis Creek Bypass, Cache Slough, Lindsey Slough, and the Sacramento River north of Rio Vista to the Yolo County line.

Sutter County

The total acreage of Important Farmland inventoried in Sutter County in 2006 was 292,256 acres, of which 165,817 acres were designated Prime Farmland, 107,194 acres were designated Farmland of State Importance, and 19,245 acres were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is found throughout the county, including in areas located immediately adjacent to potential bank protection sites along the Sutter Bypass, Tisdale Bypass, Sacramento River, the lower Feather River, and Yuba River.

Tehama County

Of the 231,513 acres of Important Farmland inventoried in Tehama County in 2006, 63,707 acres were designated Prime Farmland, 17,284 acres were designated Farmland of State Importance, and 18,085 acres were designated Unique Farmland (California Department of Conservation 2006). Important Farmland is concentrated in the central portion of the county, including in areas located immediately adjacent to potential bank protection sites along Elder Creek and Deer Creek.

Yolo County

In 2006, 390,252 acres of land were designated Important Farmland in Yolo County, of which 257,893 acres were designated Prime Farmland, 16,989 acres were designated Farmland of State Importance, and 50,197 acres were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is concentrated in the eastern and southeastern portions of the county, including in areas located immediately adjacent to potential bank protection sites along Yolo Bypass, Willow Slough Bypass, Putah Creek, and the Sacramento River.

Yuba County

Land in Yuba County designated as Important farmland totaled 85,384 acres in 2006. Of this, 41,993 were designated Prime Farmland, 11,019 acres were designated Farmland of State Importance, and 32,372 acres were designated Unique Farmland (California Department of Conservation 2006). Irrigated farmland is concentrated in the western portion of the county, including in areas located immediately adjacent to potential bank protection sites along the Feather River, Honcut Creek, Yuba river, and Bear River.

Williamson Act Contracts

Potential bank protection sites in the program area are abutted by land enrolled in Williamson Act contracts. Acreages of land enrolled in Williamson Act contracts are presented by county in Table 13-4. Under the California Land Conservation Act of 1965, commonly referred to as the Williamson Act, agricultural and open space lands are preserved through contracts with private landowners. By entering into a Williamson Act contract, the landowner foregoes the possibility of converting agricultural land to nonagricultural use for a rolling period of 10 years in return for lower property taxes. Brief descriptions of Williamson Act lands within each county and in the vicinity of the program area are included below.

Table 13-4. Acreages of Lands Enrolled in Williamson Act Contracts in 2007 by County

County	Area (acres)
Butte	215,882
Colusa	319,551
Glenn	416,544
Placer	42,601
Sacramento	187,102
Solano	268,845
Sutter	63,022
Tehama	800,003
Yolo	416,340
Yuba*	0

Notes:
* Yuba County was not enrolled in the Williamson Act Program in 2007.
Source: California Department of Conservation 2007.

Butte County

The majority of lands enrolled in Williamson Act contracts are found in the western half of the county, including a number of prime agricultural lands located immediately adjacent to potential bank protection sites along the Cherokee Canal and Butte Creek.

Colusa County

The majority of lands enrolled in Williamson Act contracts are found in the eastern portion of the county, including a number of prime and non-prime agricultural lands and farmland security zone lands located immediately adjacent to potential bank protection sites along the Colusa Drain and Sacramento River.

Glenn County

Prime agricultural lands and farmland security zone lands enrolled in Williamson Act contracts are found in the eastern portion of the county, where a number of parcels are located immediately adjacent to the bank protection sites along the Sacramento River. Non-prime agricultural lands are primarily located in the central portion of the county, well outside of the program area.

Placer County

The majority of lands enrolled in Williamson Act contracts are found in the western portion of Placer County, including a number of prime and non-prime agricultural lands located immediately adjacent to potential bank protection sites along Coon Creek and the Natomas Cross Canal. No Williamson contracts are currently in place in the vicinity of the Bear Creek setback levee and restoration sites.

Sacramento County

Prime agricultural lands enrolled in Williamson Act contracts are found in the southwestern portion of the county, where a number of parcels are located immediately adjacent to potential bank protection sites along the Sacramento River and the Delta. Non-prime agricultural lands are primarily located in the eastern portion of the county, well outside of the program area.

Solano County

Prime agricultural lands enrolled in Williamson Act contracts are found in the northern portion of the county, where a number of parcels are located immediately adjacent to potential bank protection sites along the Sacramento River, Putah Creek, Ulatis Creek Bypass, Cache Slough, Lindsey Slough, the Sacramento River, and the Delta. Non-prime agricultural lands are primarily located in the southern portion of the county, well outside of the program area.

Sutter County

Prime agricultural lands enrolled in Williamson Act contracts are evenly scattered throughout the county, including a number of parcels that abut proposed bank protection sites along the Sutter Bypass, Tisdale Bypass, Sacramento River, the lower Feather River, and Yuba River. Non-prime agricultural lands are primarily located in the northern portion of the county, well outside of the program area.

Tehama County

The majority of lands enrolled in Williamson Act contracts are found in the central portion of county, including a number of prime agricultural lands located immediately adjacent to potential bank protection sites along Elder Creek and Deer Creek.

Yolo County

Prime agricultural lands enrolled in Williamson Act contracts are found in the eastern and southeastern portions of the county, where a number of parcels are located immediately adjacent to potential bank protection sites along Yolo Bypass, Willow Slough Bypass, Putah Creek, and the Sacramento River. Non-prime agricultural lands are primarily located in the western portion of the county, well outside of the program area.

Yuba County

As of 2007, Yuba County was not enrolled in the Williamson Act Program; consequently, there are no Williamson Act parcels in the vicinity of program area.

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, regional, and local laws, regulations, and policies that pertain to land use and agricultural resources within the program area. Pertinent laws, regulations, policies, and plans are listed below.

- Federal:
    - National Environmental Policy Act
    - Farmland Protection Policy Act
- State:

    - California Environmental Quality Act
    - California Farmland Mapping and Monitoring Program
    - California Land Conservation Act of 1965 (Williamson Act)
    - Delta Protection Act of 1992
- Local:
    - Butte Regional Conservation Plan
    - Natomas Basin Habitat Conservation Plan
    - Yuba-Sutter Habitat Conservation Plan/Natural Communities Conservation Plan
    - Yolo Natural Heritage Program
    - Butte County General Plan
    - Colusa County General Plan
    - Glenn County General Plan
    - Placer County General Plan
    - American River Parkway Plan
    - Sacramento County General Plan
    - Solano County General Plan
    - Sutter County General Plan
    - Tehama County General Plan
    - Yolo County General Plan
    - Yuba County General Plan

Determination of Effects

This section describes the methodology used to evaluate the proposed program's effects on land use and agriculture. The information used to determine effects on land use and agriculture and any applicable laws, regulations, and policies are described in this chapter's Environmental Setting section and in Appendix C, Regulatory Background.

This section describes how impacts on land use and agriculture in the program area were evaluated, and the significance thresholds used to conclude whether an effect would be significant.

Assessment Methods

Effects related to land use were assessed qualitatively based on professional judgment in light of the land uses that occur in the immediate vicinity of the program area. The effects analysis in this chapter focuses on evaluating potential impacts of the proposed program and alternatives on existing land uses and local land use plans. Information on related recreational impacts is presented in Chapter 14, Recreation. Issues related to the conversion of agricultural lands as an indirect result of changing patterns of land use in the program area are discussed in Chapter 22, Growth-Inducing Effects.

The significance criteria used to evaluate the effects of the proposed program on land use and agricultural resources are generally based on the State CEQA Guidelines Appendix G criteria, with the following two notable exceptions.

- The threshold that relates to Williamson Act contracts is not relevant to this analysis because Williamson Act contracts are deemed null and void when Williamson Act land is acquired in lieu of eminent domain for a public improvement by a public agency (Government Code Section 51295). Therefore, this effect will not be discussed further in this chapter.
- The proposed program's consistency with local and regional HCPs and NCCPs is not evaluated under the threshold that relates to conflicts with applicable land use plans; rather, this issue is addressed in Chapter 12, Wildlife, and will not be discussed further in this chapter.

Significance Criteria

For this analysis, an effect pertaining to land use or agricultural resources was considered significant if it would result in any of the following environmental effects, which are based on the State CEQA Guidelines Appendix G (14 CCR 15000 et seq.).

- Physically divide an established community.
- Conflict with any applicable land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect by an agency with jurisdiction over the project.
- Convert prime farmland, unique farmland, or farmland of statewide importance.
- Cause a conflict with existing zoning for agricultural use.
- Involve other changes in the existing environment, which because of their location or nature, could result in conversion of farmland to nonagricultural use.

Presently, bank protection measures and flood protection structures are not specifically identified within some of the applicable local zoning ordinances, but they would constitute public facilities, which many local jurisdictions recognize as consistent with all zoning districts. Further, sections 65302.9 and 65860.1 of the California Government Code declare that flood protection in the Sacramento River and San Joaquin Rivers drainage areas is a matter of statewide concern, and require each city and county within the Sacramento-San Joaquin Valley to amend its general plan and zoning ordinances to be consistent with the Central Valley Flood Protection Plan and adopt goals, policies, and objectives to reduce the risk of flood damage. General plan amendments must occur within 24 months of July 2, 2013, and zoning ordinance amendments must occur within 12 months of general plan amendments. The fourth criterion above regarding whether or not the proposed program would conflict with existing zoning for agricultural use is therefore not discussed further in this analysis.

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, regular operation and maintenance (O&M) of the levee system would continue as presently executed by the local maintaining entities (subject to revision of the governing O&M manual), but construction activities associated with the proposed program would not occur. As a result, erosion would continue and the risk of levee failure and possible catastrophic flooding would increase as more erosion sites become critical and repair is limited to emergency response by federal, state, or local flood control agencies that would eventually implement bank protection at various sites along Sacramento River Flood Control Project levees through emergency action. Emergency repairs would likely result in effects on adjacent agricultural lands and other land uses similar to the proposed program.

Alternative 2A—Low Maintenance

Effect LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor

A number of rural and urban communities are located in the vicinity of potential bank protection sites and throughout the program area. Alternative 2A entails filling the eroded portion of the bank and installing revetment along the levee slope and streambank from the levee's toe to crest. Alternative 2A would be most applicable in areas where there is inadequate space or substantial constraints to acquiring sufficient real estate to construct setback levees or other measures, either landside or waterside. However, construction associated with the proposed program would not be expected to divide an established community because all of the communities in the program area are already subject to existing limitations on growth and community cohesion as a result of being located in the vicinity of a natural watercourse. Consequently, any changes in land use associated with implementation of Alternative 2A would not likely result in physically dividing an established community. No significant effects would occur, and no mitigation is required.

Effect LA-2: Conflicts with Local Land Use and Agriculture Policies

Alternative 2A is not expected to permanently encroach upon or conflict with adjacent agricultural uses, although construction activities could require temporary lane closures or re-routing of traffic, which would result in potential short-term effects on farmers and agriculture-related operations. However, these effects would be temporary and not considered significant. See Chapter 7, Transportation and Navigation, for a detailed discussion of traffic-related effects of construction activities, and of Mitigation Measure TN-MM-1: Implement a Traffic Control and Road Maintenance Plan.

Construction of Alternative 2A would potentially result in encroachment on existing recreational lands or facilities in the program area, reducing the allowable recreational uses at certain locations. While this type of reduction of activities at individual sites may occur, the proposed program would at the same time protect adjacent land uses from flooding. The proposed program would also maintain the existing planform of the river corridor and access along and to the river. Overall, the proposed program is considered to be consistent with applicable local planning policies regarding flood protection for local communities and the continued provision of open space corridors along the Sacramento River and its tributaries. Therefore, the proposed program is considered consistent with the applicable local policies for management and use of program area lands, despite the potential reduction in activities at individual sites noted regarding the use of these lands for recreation and natural resources. This effect is considered less than significant, and no mitigation is required.

Effect LA-3: Conversion of Important Farmland to Nonagricultural Uses

Alternative 2A entails installing revetment along the levee slope and streambank from the levee's toe to crest, and is not expected to permanently encroach upon or result in the conversion of Important Farmlands to nonagricultural uses.

Construction associated with the proposed program would require the establishment of construction staging areas for equipment laydown, soil stockpiling, and vehicle parking, potentially disrupting the use of some adjacent agricultural lands. As described in more detail in Chapter 2, Project Description, materials would be brought to individual sites either by barge (waterside construction) or via surface roads. Haul routes to those sites requiring landside access would be via interstate and U.S. highways, state highways, county and city roads, and levee access roads. Construction materials, including quarry stone, would be hauled from a commercial or previously permitted quarry or borrow site located within 100 miles of the site. Temporary lane closures and, in some instances, full road closures may be required. See Chapter 7, Transportation and Navigation, for a detailed discussion of traffic-related effects of construction activities, and of Mitigation Measure TN-MM-1: Implement a Traffic Control and Road Maintenance Plan.

These construction activities would result in short-term effects on farmers and agriculture-related operations on Important Farmlands, such as temporary delays in the movement of agricultural equipment and/or temporary disruption of farming activities as a result of staging areas within site-specific project areas. However, these effects would be temporary and are not considered significant because they are not expected to cause permanent encroachment upon or conversion of Important Farmlands to nonagricultural uses. The following avoidance and minimization measures will be used during project-level design:

- Design bank protection projects to avoid or minimize the direct conversion of Important Farmland to nonagricultural uses.
- Locate borrow sites and construction staging areas on sites that are fallow, that are already developed or disturbed, or that are to be discontinued for use as agricultural land.
- Use existing roads to access construction areas to the extent possible.

This effect is considered less than significant.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor

Effects associated with Alternative 3A would be similar to those described for Alternative 2A, but would occur at a greater magnitude because this alternative would involve construction of adjacent and setback levees. Improvements under a setback levee would result in the construction of a new levee some distance from the existing levee. A widened landside footprint would result, whereby a new levee would be constructed on the landward side of the existing levee. Although it cannot be known at this time precisely how far landward the footprint would extend for the flood control facilities under this alternative, a comparatively greater extent of land would be displaced by these improvements than under Alternative 2A. In addition to removing mature woody vegetation within the vegetation-free zone (VFZ), the proposed improvements would potentially remove the edges of adjacent agricultural parcels from agricultural use in some locations and could also potentially displace some existing agricultural buildings, residences, roadways, and recreational parklands, trails, and other appurtenant facilities within the widened flood control facility footprint.

As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Although it cannot be known at this time precisely how far landward the footprint would extend for the flood control facilities under this alternative, additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

Although of greater magnitude than the effects described under Alternative 2A, the effects associated with Alternative 3A would nevertheless be similar. Further, as discussed in Chapter 15, Population and Housing, Alternative 3A would not displace a substantial number of people or residences. Therefore, construction under Alternative 3A is not expected to result in the physical division of a community. The effect would be less than significant.

Effect LA-2: Conflicts with Local Land Use and Agriculture Policies

Effects associated with Alternative 3A would be greater in magnitude than those described for Alternative 2A, because of a wider landside footprint to accommodate setback levees. However, the proposed program is considered to be consistent with the intent of applicable local planning policies regarding the continued provision of open space corridors along the Sacramento River and its tributaries, and local planning policies aimed at ensuring flood protection for local communities. Therefore, this effect is considered less than significant, and no mitigation is required.

Effect LA-3: Conversion of Important Farmland to Nonagricultural Uses

This effect under Alternative 3A would be more severe than that described under Alternative 2A because Alternative 3A would affect a greater amount of land than Alternative 2A. Implementation of a setback levee would potentially be greater in magnitude than construction of an adjacent levee because a setback levee would likely affect a wider footprint than an adjacent levee. Implementation of Alternative 3A would potentially result in the conversion of Important Farmland in order to accommodate the setback levee or adjacent levee.

As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Although it cannot be known at this time whether this alternative would result in the conversion of Important Farmland to accommodate setback levees, additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Project-level design will consider additional avoidance and minimization measures to be used, including:

- Design bank protection projects to avoid or minimize the direct conversion of Important Farmland to nonagricultural uses.

- Locate borrow sites and construction staging areas on sites that are fallow, that are already developed or disturbed, or that are to be discontinued for use as agricultural land.
- Use existing roads to access construction areas to the extent possible.

The Corps shall also evaluate the environmental significance of potential farmland conversion impacts at the project-level using the California Agricultural Land Evaluation and Site Assessment Model, which was developed by the Department of Conservation's Division of Land Resource Protection to provide lead agencies with a systematic and objective method for evaluating the potential impacts of proposed projects on agricultural resources. Implementation of Alternative 3A could potentially result in the conversion of Important Farmland. This would constitute a significant effect. Mitigation Measure LA-MM-1 would reduce the effect of converting these lands to nonagricultural uses under Alternative 3A. However, even with the incorporation of Mitigation Measure LA-MM-1, the effect would remain significant and unavoidable because conversion of Important Farmland could still occur and may not be fully mitigated.

Mitigation Measure LA-MM-1: Evaluate the Potential for Direct Farmland Conversion at the Project Level and Avoid, Minimize, and Compensate for Loss of Farmland

Compensate for unavoidable Important Farmland conversion impacts by:

- Protecting productive off-site agricultural land subject to conversion through the purchase or transfer of its development rights. Agricultural conservation easements shall be acquired at a 1:1 ratio, and the lands on which the easements are acquired shall be maintained in agricultural use.
- Paying any applicable agricultural land mitigation fees, as required by a local government agency with jurisdiction over the project.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effects under Alternative 4A would be similar to those under Alternative 3A, but at a lesser magnitude because the specific bank protection measures proposed under Alternative 4A are primarily located on the water side of the levee, have a much smaller overall footprint, and, as a result, affect substantially less land (see Chapter 2, Project Description, Proposed Site-Specific Bank Protection Measures). Under Bank Protection Measure 4, constructed benches would be planted with riparian vegetation, and revegetation would occur in areas where setback levees and adjacent levees are constructed. Further, off-site mitigation has been an acceptable means of mitigation to the regulatory resource agencies and mitigation would be provided within the region of impact (e.g., Regions 1a, 1b, 2, or 3).

Effect LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor

Effects associated with Alternative 4A would be comparable in type and magnitude to those described for Alternative 3A. The improvements under Alternative 4A would not result in the physical division of a community, and the effect would be less than significant.

Effect LA-2: Conflicts with Local Land Use and Agriculture Policies

Under Alternative 4A, this effect would be comparable in type and magnitude to that described for Alternative 3A, except for the program area that encompasses Colusa County. As described in Appendix C, Regulatory Background, the 2011 Colusa County Draft General Plan Agricultural Element contains policies specific to the creation and management of habitat on agricultural lands. Habitat management cannot be considered a legitimate use of agricultural land in Colusa County and requires a general plan amendment to change the land use designation to "Resource Conservation." Because off-site mitigation is acceptable under this alternative, there is a potential that implementation of some bank protection measures will result in the need for off-site mitigation within lands designated for agricultural use. It cannot be known at this time whether this alternative would conflict with the Colusa County General Plan or require a general plan amendment. However, additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address any policy issues associated with site-specific erosion sites, including those required in Colusa County.

Following appropriate compliance with relevant policies, which may include a general plan amendment in Colusa County, the improvements under Alternative 4A would not result in substantial conflicts with local land use planning policies, and the effect would be less than significant.

Effect LA-3: Conversion of Important Farmland to Nonagricultural Uses

Effects associated with Alternative 4A would be comparable in type to Alternative 3A, because implementation of Alternative 4A would include the construction of setback levees. Because this alternative applies a combination of site-specific bank protection measures (Bank Protection Measures 1–5), setback levees would be applied to fewer sites than under Alternative 3A (which is limited to the application of setback and adjacent levees). Consequently, this effect under Alternative 4A would be lesser in magnitude than Alternative 3A.

However, implementation of Alternative 4A would still potentially result in the conversion of Important Farmland in order to accommodate the setback levee. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Although it cannot be known at this time whether this alternative would result in the conversion of Important Farmland to accommodate setback levees, additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

Implementation of Alternative 4A could potentially result in the conversion of Important Farmland. This would constitute a significant effect. Mitigation Measure LA-MM-1 would reduce the effect of converting these lands to nonagricultural uses under Alternative 4A. However, even with the incorporation of Mitigation Measure LA-MM-1, the effect would remain significant because conversion of Important Farmland could still occur.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effects under Alternative 5A would be similar to those under Alternative 3A, because Alternative 5A involves a similar set of site-specific bank protection measures, with the exception of adjacent levees. Also, fewer setback levees would be constructed under this alternative.

Effect LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor

Effects associated with Alternative 5A would be comparable in type and magnitude to those described for Alternative 3A. The improvements under Alternative 5A would not result in the physical division of a community, and the effect would be less than significant.

Effect LA-2: Conflicts with Local Land Use and Agriculture Policies

Effects associated with Alternative 5A would be comparable in type and magnitude to those described for Alternative 4A, which include the need for a general plan amendment if agricultural land is converted to a Resource Conservation designation in order to provide mitigation for natural resource effects. The improvements under Alternative 5A would not result in substantial adverse conflicts with local land use planning policies, and the effect would be less than significant.

Effect LA-3: Conversion of Important Farmland to Nonagricultural Uses

Effects associated with Alternative 5A would be comparable in type to Alternative 3A because implementation of Alternative 5A also includes the application of setback levees (although at fewer sites than under Alternative 3A). However, implementation of Alternative 5A would still potentially result in the conversion of Important Farmland in order to accommodate the setback levee. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Although it cannot be known at this time whether this alternative would result in the conversion of Important Farmland in to accommodate setback levees, additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

Implementation of Alternative 5A could potentially result in the conversion of Important Farmland. This would constitute a significant effect. Mitigation Measure LA-MM-1 would reduce the effect of converting these lands to nonagricultural uses under Alternative 5A. However, even with the incorporation of Mitigation Measure LA-MM-1, the effect would remain significant and unavoidable because conversion of Important Farmland could still occur.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effects under Alternative 6A would be comparable in type and magnitude as they would be under Alternative 4A; however, there would be no application of Bank Protection Measure 2 (bank fill stone protection with no on-site vegetation), or Bank Protection Measure 3 (adjacent levee).

Effect LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor

This effect would be the same as under Alternative 4A.

Effect LA-2: Conflicts with Local Land Use and Agriculture Policies

This effect would be the same as under Alternative 4A.

Effect LA-3: Conversion of Important Farmland to Nonagricultural Uses

This effect would be the same as under Alternative 4A.

Chapter 14
Recreation

Introduction and Summary

This chapter describes the environmental setting associated with recreation, the determination of effects, the environmental effects on recreation that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- American River Parkway Plan, 2008.
- Butte County General Plan, 2010.
- Colusa County General Plan, 2011.
- Glenn County General Plan, 1993.
- Placer County General Plan, 1994.
- Sacramento County General Plan, 2011.
- Solano County General Plan, 2008.
- Sutter County General Plan Policy Document, 2011.
- Tehama County General Plan, 2009.
- Yolo County General Plan, 2009.
- Yuba County General Plan, 2011.

Table 14-1 summarizes the recreation effects resulting from the implementation of the proposed program.

Table 14-1. Summary of Recreation Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
REC-1: Temporary Disruption of Recreational Opportunities during Construction	REC-MM-1: Notify Recreation Users of Potential Construction Hazards	During construction
	REC-MM-2: Provide Alternate Recreation Routes	
REC-2: Long-Term Reduction in Quality of Existing Recreational Opportunities within the Levee Corridor	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Post-construction
REC-3: Temporary Obstruction of Access to Marina or Boat Launch Facilities	REC-MM-3: Preserve Marina and Boat Launch Access	During construction

Effect	Mitigation Measures	Implementation Period
REC-4: Permanent Loss of Recreational Opportunities	REC-MM-4: Rebuild Affected Formal Park Facilities and Trails	Post-construction
REC-5: Safety Hazards to Recreationists	REC-MM-5: Hazard-Reducing Placement of Instream Woody Material	During design

Environmental Setting

The Sacramento River, its tributaries, and its adjacent levees are popular recreation venues for local residents and visitors. While recreation opportunities vary among locations along the river, recreationists are attracted to in-water recreation as well as off-water recreation on the levees and facilities surrounding the river. In-water recreation activities include boating, fishing, kayaking, canoeing, floating, tubing, water skiing, and swimming. Off-water activities include bicycling, walking, hiking, bird-watching, wildlife viewing, enjoying nature trails, photography, and picnicking.

Recreation along the Sacramento River and its tributaries is varied and differs throughout the numerous reaches of the river and its tributaries.

Boating is a very common activity along the Sacramento River and many of its tributaries. Motorized boat use, water skiing, use of personal watercraft, and cruising along the river, is especially popular in various locations. Kayaking and canoeing are occasionally favored in portions of the program area. The Sacramento River also provides opportunities for sailing and windsurfing at different locations along the river. For example, windsurfing on the river from Rio Vista to the tip of Sherman Island is a common activity under favorable conditions. Formal and informal facilities support windsurfing, providing sales and rental of equipment, physical access to the water, and camping sites for windsurfers. Marinas, boat launch facilities and parks are distributed along the Sacramento River and its tributaries. The marinas and boat launching facilities range in size and amount of boat launching traffic throughout the program area. Parks and other sites adjacent to the Sacramento River and its tributaries offer a variety of outdoor recreation activities, both in-water and off-water, such as swimming, bank-fishing, observing nature and wildlife, hunting, and picnicking.

Fishing is another popular recreation activity throughout portions of the entire program area. Anglers fish from boats and the shore throughout the reaches of the river.

There are access points to the Sacramento River and its tributaries through marinas and local and state parks throughout the program area; however, many parts of the shoreline are inaccessible or not easily accessible to recreationists.

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, and local laws, regulations, and policies that pertain to recreation resources within the program area. Pertinent laws, regulations, policies, and plans are listed below.

- Federal:

- National Environmental Policy Act
- Wild and Scenic Rivers Protection Act
- State:
  - California Environmental Quality Act
  - California Wild and Scenic Rivers Act
- Local:
  - Butte County General Plan
  - Colusa County General Plan
  - Glenn County General Plan
  - Placer County General Plan
  - American River Parkway Plan
  - Sacramento County General Plan
  - Solano County General Plan
  - Sonoma County General Plan
  - Tehama County General Plan
  - Yolo County General Plan
  - Yuba County General Plan

Determination of Effects

This section describes the effects analysis relating to recreation for the proposed program. It describes the methods used to determine the impacts of the proposed program and lists the thresholds used to conclude whether an effect would be significant. Measures to mitigate significant effects accompany each discussion.

Assessment Methods

Effects on recreation were assessed using the significance criteria outlined below.

Significance Criteria

The thresholds for determining the significance of effects for this analysis are based on the environmental checklist in Appendix G of the State CEQA Guidelines and issues and concerns that have been previously encountered in implementing the bank protection program. The proposed program was determined to result in a significant effect related to recreation if it would:

- increase the use of existing neighborhood and regional parks or other recreation facilities such that substantial physical deterioration of the facility would occur or be accelerated;
- include recreation facilities or require the construction or expansion of recreation facilities that might have an adverse physical effect on the environment;

- restrict the availability or quality of existing recreation opportunities in the program vicinity;
- implement operational or construction-related activities related to the placement of program facilities that would cause a substantial long-term disruption of any institutionally recognized recreation activities; or
- result in increased risk to recreationists in or adjacent to the program vicinity.

The action alternatives do not include the construction of recreation facilities unless required as a form of mitigation. The alternatives would not increase the use of existing recreational facilities, or include the construction or expansion of recreational facilities unless required for mitigation. While construction of recreation facilities has in the past been done under Sacramento River Bank Protection Project authority, there is no nonfederal sponsor to cost-share with the federal government, and current Corps budgetary guidance limits federal participation in the construction of recreation improvements. Therefore, the first and second criteria are not discussed further in this analysis.

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, construction activities associated with the proposed program would not occur. While pre-scheduled levee maintenance activities and any required emergency repairs would continue to be conducted, the riverbanks, and associated recreation uses would remain unchanged from their current (baseline) conditions and banks would be subject to ongoing erosion and risk of levee failure. Failure of the levee at an erosion site would result in potentially significant effects on recreation resources and public safety. For example, levee failure could result in restricted availability or quality of existing recreation opportunities if linear trails or recreation facilities are damaged or flooded, Depending on the location of levee failure, a federal or state agency would likely repair the levee, but it would be the responsibility of the appropriate local or state agency to repair or rebuild the recreation facilities.

Alternative 2A—Low Maintenance

Effect REC-1: Temporary Disruption of Recreational Opportunities during Construction

There is a substantial variety of type and intensity of recreation that occurs at sites along the Sacramento River and its tributaries. Some sites are very popular for outdoor recreation, while others have no public access or receive little or no recreation use. Recreation activities along the river and its tributaries occur both in the river and along its banks and levees, including, but not limited to, boating, fishing, swimming, walking, bicycling, and enjoying the waterfront.

Recreation activities would be disrupted while rock revetment is installed along the levee slope and streambank from the levee toe to the levee crest. The levee crown and adjacent construction and staging areas likely would be closed to public access at most of the project sites during construction. In places where construction occurs close to recreation areas, the areas themselves may not be closed but the proximity to construction equipment and activity may degrade recreation experiences.

During construction on the bank slope, shoreline fishing would be prohibited at specific construction sites to avoid hazards to the public.

The levee crown may be closed during construction. At some project sites where there is a bike trail on the levee crown or adjacent to the levee, bicyclists and pedestrians who use the trail would be affected. However, areas just upstream and downstream of specific project sites likely would remain open for recreational uses.

The installation of rock along the bank may require that construction take place from the waterside of the levee. This activity could temporarily disrupt boating and personal watercraft activities along the Sacramento River and its tributaries. Temporary disruption to recreational boating would result from the presence of construction barges and associated equipment, vehicles, and personnel in and adjacent to the river.

Construction at each site generally would take one season to complete. In many cases, there are alternative locations for recreational activity relatively close to the construction sites. However, this effect is considered significant. Implementation of Mitigation Measures REC-MM-1 and REC-MM-2 would reduce this effect to a less-than-significant level.

Mitigation Measure REC-MM-1: Notify Recreation Users of Potential Construction Hazards

To reduce potential construction hazards, signage and/or buoys will be provided at each of the erosion sites to warn of the potential hazards during construction. Construction personnel will warn the public (e.g., boaters, recreationists) to stay away if they approach within 100 feet of construction equipment (e.g., barges, cranes).

Mitigation Measure REC-MM-2: Provide Alternate Recreation Routes

Where construction zones encompass recognized recreational trails, alternate routes and detours will be provided. Signage will be placed around the construction areas to identify the closed areas and alternate routes.

Effect REC-2: Long-Term Reduction in Quality of Existing Recreational Opportunities within the Levee Corridor

The bank improvements proposed for Alternative 2A would follow the Engineering Technical Letter 1110-2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures (Vegetation ETL). The Vegetation ETL does not allow woody vegetation on the slopes of the levee or within 15 feet of the waterside and landside levee toes. This would require the removal of a substantial amount of mature trees and vegetation from the banks of the Sacramento River and its tributaries within certain portions of the erosion site construction footprints.

The placement of riprap along the bank of project sites would reduce the natural qualities of these sites. The reconstructed banks would be less appealing to some users for bank fishing, swimming, picnicking, and other riverbank recreation. However, the riprap sections might become more appealing to others.

Many recreation activities are enhanced by or depend on the presence of mature woody vegetation. Recreationists, such as anglers, pedestrians, cyclists, boaters, and swimmers, use woody vegetation for shade, while wildlife and nature viewers enjoy the various wildlife and aesthetic values that this vegetation supports and for the visual characteristics it contributes to the landscape. Permanent loss of woody vegetation on and within 15 feet of levees along the Sacramento River and its tributaries would substantially reduce the quality of existing recreation activities and is therefore considered a significant effect. At construction sites where feasible, implementation of Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat (described in Chapter 10, Vegetation and Wetlands), would reduce but may not fully compensate for effects. At construction sites where this mitigation measure is not feasible, the effect would remain significant and unavoidable.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effects REC-1 and REC-2, described above under Alternative 2A, would apply to Alternative 3A. Mitigation measures for these effects are REC-MM-1, REC-MM-2, and VEG-MM-1, also described above. However, under Alternative 3A the creation of additional floodplain to support riparian habitat and the potential to restore woody vegetation on the landside of adjacent levees would offset the loss of woody riparian vegetation to a greater degree than in Alternative 2A because some level of mitigation would occur on site.

Effect REC-3: Temporary Obstruction of Access to Marina or Boat Launch Facilities

During the construction of a setback levee or adjacent levee, access to boat ramps may be affected because levee roads could be closed temporarily by construction activities. Closing of boat ramps if safe access cannot be provided would reduce recreational boating opportunities and could reduce revenue for marina operations. This effect is considered significant. Implementation of Mitigation Measure Rec-MM-3 would reduce this effect to a less-than–significant level.

Mitigation Measure REC-MM-3: Preserve Marina and Boat Launch Access

The Corps and CVFPB will work with the owners and operators of marinas and boat launches to ensure that access is maintained to marinas and boat launch facilities during project construction.

Effect REC-4: Permanent Loss of Recreational Opportunities

Setback and adjacent levee construction would involve the placement of a new levee some distance landward of, or adjacent to, the existing levee. For setback levees, the land between the setback levee and the old levee would act as a floodplain. While the construction of a setback levee may create new recreation opportunities at some program locations, it could also cause some recreation areas to be closed entirely. The location of the setback levee may lead to occasional inundation of the area during a high flow event, thus reducing the opportunity for recreation activities. In addition, the construction of an adjacent levee could occur in a recreation area and cause it to be closed.

Any parks or trails that sit adjacent to the existing levee or within the footprint of the setback levee could be affected, and portions of the park, park's facilities, or trails may have to be removed. This effect is considered significant. Implementation of Mitigation Measure REC-MM-4 would reduce this effect to a less-than-significant level.

Mitigation Measure REC-MM-4: Rebuild Affected Formal Park Facilities and Trails

The Corps and CVFPB will ensure that formal park facilities, such as fields or trails, that are affected by construction of a setback levee or adjacent levee are rebuilt upon completion of levee construction. With the implementation of this mitigation measure, there would be no permanent loss of recreation opportunities.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect REC-1: Temporary Disruption of Recreational Opportunities during Construction

This effect would be the same as under Alternative 2A. Implementation of Mitigation Measures REC-MM-1 and REC-MM-2 would reduce this effect to a less-than-significant level.

Effect REC-2: Long-Term Reduction in Quality of Existing Recreational Opportunities within the Levee Corridor

This effect would be the same as under Alternative 2A. However, in areas where setback levees are constructed, the creation of additional floodplain to support riparian habitat and the potential to restore woody vegetation on the landside of adjacent levees would offset the loss of woody riparian vegetation to a greater degree than in Alternative 2A because some level of mitigation would occur on site. At construction sites where feasible, implementation of Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat, would reduce the effect but may not fully compensate for effects. At construction sites where this mitigation measure is not feasible, the effect would remain significant and unavoidable.

Effect REC-3: Temporary Obstruction of Access to Marina or Boat Launch Facilities

This effect would be the same as under Alternative 3A, but at a potentially lesser magnitude because fewer setback levees and adjacent levees would be constructed under Alternative 4A. Implementation of Mitigation Measure Rec-MM-3 would reduce this effect to a less-than-significant level.

Effect REC-4: Permanent Loss of Recreational Opportunities

This effect would be the same as under Alternative 3A, but at a potentially lesser magnitude because fewer setback levees and adjacent levees would be constructed under Alternative 4A. Implementation of Mitigation Measure REC-MM-4 would reduce this effect to a less-than-significant level.

Effect REC-5: Safety Hazards to Recreationists

There are typical river hazards along the Sacramento River and its tributaries that recreationists face when they participate in in-water or off-water activities. The hazards include ledge and/or hole hydraulics, sweepers and strainers (downed tree snags), vertical riverbanks, and foot entrapment in riprap. The hazards vary by site along the river and its tributaries.

Foot entrapment is a potential hazard for swimmers, waders, anglers, and other recreationists along the bank protection sites. Foot entrapment would be avoided by the use of relatively uniform gradation in rock sizes, including a full range of small, medium, and large rocks that would preclude the presence of large voids.

Instream woody material (IWM) would be incorporated at project sites to ensure that fish habitat is of the highest quality possible. IWM would be anchored to the levee bank so that it lies within the flowing channel without floating downstream. IWM acts as fish habitat for sensitive species that use the Sacramento River and its tributaries. There is evidence, however, that the placement of this type of material and even the natural existence of it may pose a threat to recreationists, especially swimmers, boaters, and canoeists (Jones & Stokes 1999). Hazards are most likely to result when the IWM is beneath the water but fairly shallow (Jones & Stokes 1999). Hazards resulting from IWM include minor to serious injury and possibly death, damage to boat motors and propellers, and damage to rafts, canoes, and other small watercraft. This effect would be significant. Implementation of Mitigation Measure REC-MM-5 would reduce this effect to a less-than-significant level.

Mitigation Measure REC-MM-5: Hazard-Reducing Placement of Instream Woody Material

The placement of IWM is directly related to its hazard potential. The incorporation of the following design factors would avoid and/or minimize risks to recreationists.

Visibility of IWM will be ensured and IWM design will incorporate the use of natural indicators, such as a partially emergent portion of IWM, or vegetation on the low berm, to act as a visual warning of the presence of shallowly submerged hardscape. This would ensure visual warning so that boaters, swimmers, and other recreationists would have adequate time to avoid the IWM and possibly injury or damage to property. Alternatively, the materials would be placed at least 2 feet below the normal summer flow to reduce the hazard to power boaters and paddlers.

IWM will be placed facing downstream (or rootwads would be used), thus reducing the risk to recreationists flowing with the river current, especially swimmers and canoeists.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect REC-1: Temporary Disruption of Recreational Opportunities during Construction

This effect would be the same as under Alternative 2A. Implementation of Mitigation Measures REC-MM-1 and REC-MM-2 would reduce this effect to a less-than-significant level.

Effect REC-2: Long-Term Reduction in Quality of Existing Recreational Opportunities within the Levee Corridor

This effect would be the same as under Alternative 2A. However, in areas where setback levees are constructed, the creation of additional floodplain to support riparian habitat and the potential to restore woody vegetation on the landside of adjacent levees would offset the loss of woody riparian vegetation to a greater degree than under Alternative 2A because some level of mitigation would occur on site. At construction sites where feasible, implementation of Mitigation Measure VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat, would reduce this effect but may not fully compensate for effects. At construction sites where this mitigation measure is not feasible, the effect would remain significant and unavoidable.

Effect REC-3: Temporary Obstruction of Access to Marina or Boat Launch Facilities

This effect would be the same as under Alternative 3A, but at a potentially lesser magnitude because fewer setback levees and adjacent levees would be constructed under Alternative 5A. Implementation of Mitigation Measure Rec-MM-3 would reduce this effect to a less-than-significant level.

Effect REC-4: Permanent Loss of Recreational Opportunities

This effect would be the same as under Alternative 3A, but at a potentially lesser magnitude because fewer setback levees and adjacent levees would be constructed under Alternative 5A. Implementation of Mitigation Measure REC-MM-4 would reduce this effect to a less-than-significant level.

Effect REC-5: Safety Hazards to Recreationists

This effect would be the same as under Alternative 4A. Implementation of Mitigation Measure REC-MM-5 would reduce this effect to a less-than-significant level.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effects associated with Alternative 6A would be comparable in type and magnitude to those described above for Alternative 4A, except that effect REC-2 would be of a lesser magnitude because a number of the bank protection measures involved in Alternative 6A include protection of existing vegetation and placement of on-site mitigation vegetation within the vegetation-free zone. Effects REC-1 through REC-5 would apply to this alternative, as would Mitigation Measures REC-MM-1 through REC-MM-5, and VEG-MM-1.

Chapter 15
Population and Housing

Introduction and Summary

This chapter describes the environmental setting associated with population and housing, the determination of effects, the environmental effects on population and housing that would result from implementation of the proposed action, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- Program area county general plans and corresponding housing elements.
- U.S. Census Bureau QuickFacts (2012).

Table 15-1 summarizes the population and housing effects resulting from the implementation of the proposed program.

Table 15-1. Summary of Population and Housing Effects

Effect	Mitigation	Implementation Period
POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere	None required	Not applicable

Environmental Setting

Existing Conditions

Regional

The metropolitan area of Sacramento serves as the program area's urban core and is connected to smaller cities, such as Chico, Yuba City, West Sacramento, Davis, and Elk Grove, by major roadways in the region. While much of the program area is still in agricultural production, there has been and continues to be a conversion of agricultural land to urban and suburban land uses. This trend is evident around the outskirts of Chico, Yuba City, Davis, Sacramento, West Sacramento, and Elk Grove. Many of the small, agrarian communities in this region, such as Live Oak, Colusa, Woodland, and Rio Vista, are experiencing similar growth.

Program Area

As described in Chapter 2, Project Description, the program area spans the counties of Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba. The counties vary in density, and generally range from rural in Regions 1a, 2, and 3 (i.e., Delta area, agricultural and open space area), to suburban/urban in Region 1b (i.e., cities of Sacramento and West Sacramento). Suburban communities are located throughout all of the regions. In addition to public and private docks, businesses, and campgrounds, homes are interspersed among woodland on the waterside of program levees. The population in 2010 by county within the program area is presented in Table 15-2.

Table 15-2. Populations by County for 2010

Butte	Colusa	Glenn	Placer	Sacramento	Solano	Sutter	Tehama	Yolo	Yuba
220,000	21,419	28,122	348,432	1,418,788	413,344	94,737	63,463	200,849	72,155

Source: U.S. Census Bureau 2012

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, and local laws, regulations, and policies that pertain to population and housing issues within the program area. Pertinent laws, regulations, policies, and plans are listed below.

- Federal:
  - National Environmental Policy Act
  - Uniform Relocation Assistance and Real Property Acquisition Policies Act
- State:
  - California Environmental Quality Act
  - California Relocation Act
  - Relocation Assistance and Real Property Acquisition Guidelines
- Local:
  - Butte County General Plan
  - Colusa County General Plan
  - Glenn County General Plan
  - Placer County General Plan
  - Sacramento County General Plan
  - Solano County General Plan
  - Sutter County General Plan
  - Tehama County General Plan
  - Yolo County General Plan
  - Yuba County General Plan

Determination of Effects

Assessment Methods

Potential effects on population and housing are based on the potential for construction, maintenance, and monitoring activities associated with the proposed program, which would take place incrementally over several years, to affect the population and housing resources in the program area.

Significance Criteria

For this analysis, an effect pertaining to population and housing was considered significant under NEPA and significant under CEQA if it would result in either of the following environmental effects:

- Induce population growth in an area, either directly (e.g., by proposing new homes and businesses) or indirectly (e.g., through extension of roads or other infrastructure).
- Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere.

The significance criteria were developed based on professional practice and State CEQA Guidelines Appendix G. Growth-inducing effects of the proposed program are addressed in Chapter 22, and, therefore, are not discussed further in this chapter.

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, regular operation and maintenance (O&M) of the levee system would continue as presently executed by the local maintaining entities (subject to revision of the governing O&M manual), but construction activities associated with the proposed program would not occur. As a result, erosion would continue and the risk of levee failure and possible catastrophic flooding would increase as more erosion sites become critical and repair is limited to emergency response. Under Alternative 1, increased risk of levee failure and flooding would threaten a large population and substantial improvements in the program area and possibly displace people and residences. Although no construction associated with the proposed program would occur, current policy is to protect eroding sites during emergencies. This policy may result in construction associated with emergency actions. However, this alternative would not result in any construction associated with the proposed program. The effects of Alternative 1 on population and housing would be less than significant.

Alternative 2A—Low Maintenance

Effect POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere

Under Alternative 2A, structures (i.e., residences, outbuildings, agriculture-related structures) may need to be relocated to implement bank protection if such structures are located on or adjacent to erosion repair sites. It would be infeasible however to predict the number of structures, homes, or people affected under Alternative 2A because the footprints of most of these projects are not known yet. However, based on analysis of the 106 representative sites, it is not anticipated that Alternative 2A would require construction of new housing to provide relocation of residences or to accommodate workers, and would not involve the displacement of a substantial number of people or residences. A site-specific analysis will be undertaken during subsequent project-level environmental documentation. The environmental effects associated with relocation/demolition of structures are addressed in Chapter 18, Public Health and Environmental Hazards.

Bank protection would provide a benefit to existing populations, homes, businesses, and other improvements by increasing the level of flood protection in the program area. Without the implementation of proposed bank protection measures at critical erosion sites, increased risk of levee failure and flooding would threaten a large population and substantial improvements in the program area, and possibly displace people and residences.

Any potential relocation of residents would be conducted in compliance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act, the California Relocation Act, and the Relocation Assistance and Real Property Acquisition Guidelines. Pursuant to these federal and state relocation laws, appropriate compensation would be provided to displaced landowners and tenants, and residents would be relocated to comparable replacement housing. This effect would be less than significant under Alternative 2A.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere

The effects of Alternative 3A on population and housing would be similar to those described under Alternative 2A, but possibly to a greater magnitude because the setback and adjacent levees would require an expanded footprint that could displace a greater number of residences.

As discussed in more detail in Chapter 13, Land Use and Agriculture, the proportion of different land uses varies by counties within the program area. The majority of the program area consists of undeveloped agricultural fields and grassland. Large-scale urban development is concentrated in a few centralized locations (i.e., the City of Sacramento and the City of West Sacramento).

Although it is not known at this time precisely how far landward the footprint would extend for the flood control facilities under this alternative, a comparatively greater extent of land would be displaced by these improvements than would be displaced under Alternative 2A. As a result, the proposed improvements under Alternative 3A would potentially displace some existing homes and people within the widened footprint. It would be infeasible however to predict the number of structures, homes, or people affected under Alternative 3A because the footprints of most of these projects are not known yet. However, based on analysis of the 106 representative sites, it is not anticipated that Alternative 3A would require construction of new housing to provide relocation of residences or to accommodate workers, and would not involve the displacement of a substantial number of people or residences. A site-specific analysis will be undertaken during subsequent project-level environmental documentation.

Any potential relocation of residents would be conducted in compliance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act, the California Relocation Act, and the Relocation Assistance and Real Property Acquisition Guidelines. Pursuant to these federal and state relocation laws, appropriate compensation would be provided to displaced landowners and tenants, and residents would be relocated to comparable replacement housing. This effect would be less than significant under Alternative 3A.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere

The effects of Alternative 4A on population and housing would be similar to those described under Alternative 2A. It would be infeasible to predict the number of structures, homes, or people affected under this alternative because the footprints of most of these projects are not yet known. However, based on analysis of the 106 representative sites, it is not anticipated that Alternative 4A would require construction of new housing to provide relocation of residences or to accommodate workers, and would not involve the displacement of a substantial number of people or residences. A site-specific analysis will be undertaken during subsequent project-level environmental documentation. Any potential relocation of residents would be conducted in compliance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act, the California Relocation Act, and the Relocation Assistance and Real Property Acquisition Guidelines. Pursuant to these federal and state relocation laws, appropriate compensation would be provided to displaced landowners and tenants, and residents would be relocated to comparable replacement housing. This effect would be less than significant under Alternative 4A.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere

The effects of Alternative 5A on population and housing would be similar to those described under Alternative 2A. It would be infeasible to predict the number of structures, homes, or people affected under this alternative because the footprints of most of these projects are not yet known. However, based on analysis of the 106 representative sites, it is not anticipated that Alternative 5A would require construction of new housing to provide relocation of residences or to accommodate workers, and would not involve the displacement of a substantial number of people or residences. A site-specific analysis will be undertaken during subsequent project-level environmental documentation. Any potential relocation of residents would be conducted in compliance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act, the California

Relocation Act, and the Relocation Assistance and Real Property Acquisition Guidelines. Pursuant to these federal and state relocation laws, appropriate compensation would be provided to displaced landowners and tenants, and residents would be relocated to comparable replacement housing. This effect would be less than significant under Alternative 5A.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere

The effects of Alternative 6A on population and housing would be similar to those described under Alternative 2A. It would be infeasible to predict the number of structures, homes, or people affected under this alternative because the footprints of most of these projects are not yet known. However, based on analysis of the 106 representative sites, it is not anticipated that Alternative 6A would require construction of new housing to provide relocation of residences or to accommodate workers, and would not involve the displacement of a substantial number of people or residences. A site-specific analysis will be undertaken during subsequent project-level environmental documentation. Any potential relocation of residents would be conducted in compliance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act, the California Relocation Act, and the Relocation Assistance and Real Property Acquisition Guidelines. Pursuant to these federal and state relocation laws, appropriate compensation would be provided to displaced landowners and tenants, and residents would be relocated to comparable replacement housing. This effect would be less than significant under Alternative 6A.

Chapter 16
Utilities and Public Services

Introduction and Summary

This chapter describes the environmental setting associated with public services and utilities, the determination of effects, the environmental effects on public services and utilities that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are program area county general plans and related documents.

Table 16-1 summarizes the utilities and public services effects resulting from the implementation of the proposed program.

Table 16-1. Summary of Utilities and Public Services Effects and Mitigation

Effect	Mitigation	Implementation Period
PUB-1: Potential Damage of Utility Infrastructure and Disruption of Service during Construction	PUB-MM-1: Verify Utility Locations, Coordinate with Utility Providers, Prepare and Implement a Response Plan, and Conduct Worker Training	Prior to construction
PUB-2: Potential Disruption to Irrigation Water Supply	PUB-MM-2: Coordinate with Irrigation Water Users Before and During Infrastructure Modifications and Minimize Disruptions to Supply	Prior to and during construction

Environmental Setting

Existing Conditions

Existing utility infrastructure, including underground natural gas pipelines, underground and overhead electrical distribution lines, aerial and underground telephone lines, and underground cable television lines, could be located near or at the individual bank repair sites. Water supply and drainage facilities and infrastructure at the individual sites could consist of storm drain outfalls, sanitary sewer lines, water pipelines, water intake structures, drainage laterals and ditches, wells, irrigation lines, and other facilities.

Water Supply and Drainage

Butte County

The primary source of water in Butte County is surface water, which meets 69% of the county's water needs. Groundwater accounts for approximately 31% of the county's needs. The majority of the county's water supply is stored in Lake Oroville as part of the State Water Project, and local irrigation districts' surface water rights are provided through the California water rights priority system. The Butte County Department of Water and Resource Conservation monitors groundwater quality, and the Butte Basin Water Users Association addresses planning and management of both groundwater and surface water resources (Butte County 2010a).

Colusa County

All domestic water systems in Colusa County are supplied with groundwater, and most irrigation systems are supplied with surface water from the Tehama-Colusa or Glenn-Colusa Canals, the Colusa Drain, or the Sacramento River. Community water systems are located in Arbuckle, Maxwell, Princeton, Grimes, Stonyford, and the Cities of Colusa and Williams. Numerous private groundwater wells are located throughout unincorporated areas of the county (Colusa County 2010).

Glenn County

Three community services districts supply domestic water in Glenn County: Elk Creek Community Services District, which serves 130 customers with water from Stony Gorge Reservoir; Butte City Community Services District, which serves 39 customers; and Artois Community Services District, which serves 52 customers (Glenn County 1993).

Placer County

The Placer County Water Agency (PCWA) operates eight individual treated water systems. These water systems include Alta, Applegate, Bianchi, Auburn/Bowman, Colfax, Foothill-Sunset, Martis Valley, and Monte Vista. Six of the water systems are supplied through water treatment plants that treat surface water supplied via the PCWA canal system (Placer County Water Agency 2009).

Sacramento County

Sacramento County Water Agency (SCWA) Zone 41 serves as the retail water service provider to eight separate service areas in unincorporated Sacramento County as well as the cities of Elk Grove and Rancho Cordova. SCWA also provides wholesale water supply to much of the Elk Grove Water Service retail service area (Sacramento County 2009).

Solano County

The Solano County Water Agency (provides untreated water to water service agencies in Solano County from the federal Solano Project and the North Bay Aqueduct of the State Water Project. The Solano County Water Agency provides water for municipal, industrial, and agricultural uses in Fairfield; Suisun City; Vacaville; Vallejo; Benicia; the Solano Irrigation District and Maine Prairie Water District service areas; the University of California, Davis; and the California State Prison in Solano County (Solano County 2008).

Sutter County

Sutter County's potable water is provided by groundwater and surface water. Yuba City is the only user of surface water for potable waters supplies in the county, although Yuba City also uses groundwater. Several other community water systems use groundwater, including: the Community of Robbins, Community of Sutter, and the Rio Ramaza Subdivision. There are many other small systems in the unincorporated areas of the county that serve only a few homes, and many homes in the county obtain water from their own wells. Yuba City diverts water from the Feather River throughout the year using four water rights permits, which currently meet the city's demands (Sutter County 2008).

Tehama County

The cities of Corning and Red Bluff each operate domestic water distribution systems that serve the residents of these communities. The remainder of the county is served by small community water systems and individual wells (Tehama County 2009).

Yolo County

The cities of Davis, West Sacramento, Winters, and Woodland; the unincorporated communities of Esparto, Knights Landing, Madison, and Yolo; and the North Davis Meadows and Wild Wings developments are served by public water systems. The El Macero, Willowbank, and Royal Oaks Mobile Home Park developments are connected to the City of Davis municipal water system (Yolo County 2009).

Yuba County

The following districts provide domestic, commercial, and/or irrigation water in Yuba County.

- Brophy Water District.
- Browns Valley Irrigation District.
- Camp Far West Irrigation District.
- Cordua Irrigation District.
- Linda County Water District.
- Ramirez Water District.
- South Yuba Water District.
- Nevada Irrigation District.
- Wheatland Water District.
- Yuba County Water Agency.
- Yuba County Water District.
- Hallwood Irrigation District.
- South Sutter Water District.
- Olivehurst Public Utility District.
- Camptonville Community Service District

In addition, other entities that provide water to users in Yuba County include the city of Wheatland and Beale Air Force Base, as well as several water companies, including California Water Service Company, which provides water to the City of Marysville, Dry Creek Mutual Water Company, Plumas Mutual Water Company, and Hallwood Irrigation Company. In many rural areas, water is also supplied from private wells. There are also some public utility corporations regulated by the California Public Utilities Commission that supply water to portions of the county (Yuba County 2009).

Wastewater

Butte

Wastewater services are provided by a combination of public sewer systems and individual on-site septic systems. Five municipal wastewater treatment systems exist within Butte County, located in Biggs, Chico, Gridley, Richvale Sanitary District and the Oroville region (Butte County 2010b).

Colusa County

There are five communities in Colusa County that are served by centralized wastewater disposal systems: Arbuckle, Maxwell, Princeton, and the Cities of Colusa and Williams. On-site septic systems are used in areas for which connection to community facilities is not feasible. The communities of Grimes, College City, Century Ranch, and Stonyford dispose of local wastewater through on-site septic systems, as do most rural residences throughout the county (Colusa County 2010).

Glenn County

Three municipal wastewater treatment facilities serve most of the urbanized portion of Glenn County: Willows, Orland, and Hamilton City (Glenn County 1993).

Placer County

The Placer County Department of Facility Services operates and maintains ten separate sanitary sewer systems within the county. Nine of the ten are either sewer maintenance districts (SMDs) or county service areas (CSAs), which derive their operating revenue from sewer user fees. Funds do not co-mingle between districts. The Placer County Board of Supervisors is the governing board of each SMD or CSA. The tenth sewer system serves the Cabin Creek Facility, with the property being owned by the County (Placer County Water Agency 2009).

Sacramento County

Existing public liquid waste facilities of Sacramento County include the regional sewer system for the Sacramento metropolitan area; sanitary sewer systems in Galt, Rancho Murrieta, Hood, Courtland, Locke, Walnut Grove, and Isleton; and dedicated, single-facility systems at the Sacramento County Boys Ranch, the Rio Cosumnes Correctional Center, and the Sacramento Metro Airport. The remainder of the county is served by private septic systems (Sacramento County 1993).

Solano County

The following water treatment plants are located in Solano County: City of Vacaville's Diatomaceous Earth (DE) Water Treatment Plant, Vacaville and Fairfield's North Bay Regional Water Treatment Plant, Fairfield's Waterman Treatment Plant, Cement-Hill Water Treatment Plant, Fleming Hill Treatment Plant, and Vallejo's Green Valley Treatment Plant. These plants filter and treat water used by county businesses and residents.

Sutter County

Yuba City owns and operates a wastewater treatment and collection system that provides sewer service for the community of Yuba City and serves a population of about 52,000. The facility also accepts septage from unsewered portions of Sutter and Yuba Counties (State Water Resources Control Board 2007).

Tehama County

Community wastewater disposal outside of these areas is handled primarily by septic tank and leach field systems or by seepage pits. On-site wastewater systems are limited by soil conditions throughout the county (Tehama County 2009).

Yolo County

Private on-site septic systems are the most common method of wastewater treatment in the unincorporated county. Individual septic systems typically require lot sizes of 0.8 to 1 acre. In areas where wells are used for domestic water supply, 1.5-acre lots may be necessary. All existing community systems in unincorporated Yolo County are managed by a CSA or community service district (CSD). Municipal wastewater systems currently serve Davis, West Sacramento, Winters, and Woodland. Wastewater treatment plants commonly provide primary and secondary treatment, and some provide tertiary treatment to meet increasingly stringent wastewater discharge standards of the state SWRCB. (Yolo County 2009).

Yuba County

Aside from the cities of Marysville and Wheatland and the communities of Linda and Olivehurst, virtually all sewage disposal in Yuba County is accomplished by means of on-site septic tank and leach field systems. In particular, septic tanks are used throughout the rural foothill and mountain communities. Marysville is served by a county-owned wastewater treatment system that serves more than 3,700 residential and commercial customers (Yuba County 2009).

Solid Waste

Butte

Solid waste management facilities in Butte County consist of the Neal Road Recycling and Waste Facility and adjacent septic waste disposal area, two transfer stations, a large materials recovery/transfer station facility, a private wood waste recycling facility, and two municipal wood waste recyclers. The City of Chico operates a compost site for green waste byproducts, and is located at the Chico Municipal Airport. Butte County is served by four licensed private haulers who provide residential, commercial, and industrial collection services (Butte County 2010b)

Colusa County

Garbage pickup service is provided by Recology Butte Colusa Counties in the cities of Colusa and Williams, as well as the unincorporated communities of Arbuckle, Maxwell, and Princeton. Solid waste facilities in the county consist of the Maxwell Transfer Station and the Stonyford Disposal Site (Colusa County 2010).

Glenn County

Solid waste in Glenn County is collected by franchised haulers, with rates set by the county board of supervisors for the unincorporated area and by the city councils in the cities of Willows and Orland. There is one sanitary landfill in the county, located on Road 33, west of the community of Artois. The landfill is on more than 195 acres leased by Glenn County for 50 years. It is a Class III facility (a facility at which protection is provided to water quality from municipal, industrial and agricultural wastes).

Placer County

The Placer County Environmental Health Services Solid Waste Program focuses on the handling and disposal of nonhazardous solid wastes, sometimes referred to as refuse, such as garbage and rubbish, including yard wastes, and construction and demolition debris.

Sacramento County

There are nine active permitted solid waste facilities in Sacramento County, including two transfer/processing stations and one landfill that are publicly owned and operated. There are also three transfer/processing stations, one construction and demolition transfer/processing station, and one landfill that are privately owned within the county. Sacramento County owns and operates Kiefer Landfill (Sacramento County 1993).

Solano County

The county contracts for solid waste management services. Various contractors serve the unincorporated communities outside of Solano County's cities. Allied Waste Industries serves the unincorporated area outside of Benicia; Vacaville Sanitary Service (Norcal Waste Systems) serves the unincorporated areas outside of the cities of Dixon, Vacaville, and Vallejo; Solano Garbage Company (Republic Services) serves the unincorporated areas outside of Fairfield and Suisun City; and Rio Vista Sanitation Service (Garaventa Enterprises) serves the unincorporated area outside of Rio Vista.

Sutter and Yuba Counties

Yuba-Sutter Disposal, Inc. (YSDI) serves more than 43,000 residential customers and 3,500 commercial customers and collects more than 100,000 tons of materials annually. YSDI provides service to the communities of Beale Air Force Base, Live Oak, Marysville, Wheatland, Yuba City, and the counties of Yuba and Sutter (Yuba-Sutter Disposal, Inc. 2009).

Tehama County

The Tehama County Sanitary Landfill Association (TCSLA) owns the Tehama County-Red Bluff Sanitary Landfill, an 83.63-acre site located approximately 2.5 miles northwest of the City of Red Bluff. The TCSLA contracts with Green Waste of Tehama for operation of the landfill. The Tehama County-Red Bluff Sanitary Landfill provides extensive services for waste diversion and offers recycling services.

Yolo County

Solid waste is disposed of at the Yolo County Central Landfill, located on County Road 28H approximately 4 miles northeast of Davis.

Electrical and Natural Gas Service

Butte

The Pacific Gas and Electric Company (PG&E) provides Butte County with most of its electricity. The cities of Gridley and Biggs run their own power companies, Gridley Municipal Utilities and Biggs Electrical Department, each of which distributes electricity purchased from the federal government to residents within their city limits. PG&E also supplies most of the natural gas used within Butte County.

Colusa County

PG&E provides electrical and natural gas services to consumers in Colusa County.

Glenn County

Natural gas and electrical service in the county are provided by PG&E. PG&E owns, operates, and maintains electric service in Glenn County. PG&E is a provider of resources to the counties affected by the proposed program.

Placer County

PG&E provides gas and electrical services to Placer County consumers.

Sacramento County

The Sacramento Municipal Utility District (SMUD) is the electrical service provider for Sacramento County and small areas of Placer County. SMUD delivers electricity to more than 553,000 customers within approximately 900 square miles of Sacramento County and a small portion of Placer County. PG&E is the natural-gas service provider.

Solano County

Natural gas service for Solano County is provided by PG&E, as regulated by the California Public Utilities Commission and the Federal Energy Regulatory Commission.

Electricity for Solano County is also provided by PG&E, as regulated by the California Public Utilities Commission and the Federal Energy Regulatory Commission. All public electrical energy for Solano County is generated outside the County and supplied via transmission lines.

Sutter County

PG&E provides electrical and natural gas service to Sutter County. Electrical service is provided to all areas of the county. Natural gas service is provided only to the urbanized areas of Yuba City and Live Oak, and to the community of Nicolaus. Most of the electrical service in the county is carried through above-ground lines. However, new urban development is now typically served by underground service. In addition, PG&E maintains a program to underground existing service lines.

Tehama County

Natural gas and electricity providers in Tehama County are franchisees regulated by the California Public Utilities Commission.

Yolo County

PG&E provides natural gas and electrical services to the residents of Yolo County.

Yuba County

PG&E is the primary service provider in Yuba County for natural gas and electricity. Natural gas is provided to urbanized areas of the county. Rural residents who run gas appliances purchase bottled propane from several providers.

Telephone and Cable

A variety of telephone service providers are within the program area. However, based on a review of affected general plans, AT&T California is the main provider of telephone services to the consumers residing within program area.

Fire and Police Protection

Butte

Various local, state, and federal agencies provide criminal justice services in Butte County. These include, but are not limited to, the police agencies in the cities of Chico, Oroville, Gridley, Biggs, and the town of Paradise; and the Butte County Sheriff, the California Highway Patrol, the State Department of Fish and Wildlife (DFW), the State Department of Parks and Recreation, and the U.S. Forest Service.

The Butte County Fire Department (BCFD), with support from the California Department of Forestry and Fire Protection (CAL FIRE), provides fire protection to the entire unincorporated county, except for a small area south of Oroville served by the El Medio Fire Protection District.

The incorporated jurisdictions of Biggs, Chico, Gridley, Oroville, Paradise, and the El Medio Fire District play an important role in providing fire protection services in the areas within their jurisdictions, as well as coordination with the BCFD in the unincorporated areas surrounding their jurisdictions.

Colusa County

The unincorporated areas of Colusa County receive general public safety and law enforcement services from the County Sheriff. Municipal police departments serve the cities of Colusa and Williams. The District Ranger has responsibility for the Mendocino National Forest. The DFW patrols the national wildlife refuges.

Fire protection services in Colusa County are provided by eight rural districts, two city fire departments, the California Department of Forestry, and the U.S. Forest Service. The majority of the districts are staffed by volunteer fire fighters. There are mutual aid agreements between most of the agencies to ensure that adequate manpower and equipment can be provided when a fire occurs.

Glenn County

The Glenn County Sheriff's Office provides law enforcement services within unincorporated areas of the county. The two incorporated cities within the county, Willows and Orland, are served by the Willows and Orland Police Departments, respectively. Fire and police protection are provided by the local and county agencies.

Fire protection in Glenn County is provided by twelve individual fire districts, which include the cities of Willows and Orland. On a seasonal basis, protection is also provided by CAL FIRE in the unincorporated foothill and rural areas. In the areas covered by the CDF that are also served by a fire district, both respond to fires during the fire season (approximately May 1 to November 1).

Placer County

The Placer County Sheriff's Department provides law enforcement services to the county, including the program area.

Sacramento County

Fire service is provided in the County of Sacramento by the cities of Folsom, Galt, Isleton and Sacramento, Elk Grove Community Services District, and fourteen other independent fire districts (Sacramento County 1993). All fire districts provide emergency medical rescue and fire protection services, while some districts also provide advanced life support via fire department ambulances, paramedic squads, or by the placement of firefighter/paramedics on engines (Sacramento County 1993).

The County Sheriff's Department provides local police protection services to the unincorporated area and provides specialized law enforcement services to both the incorporated and unincorporated areas (Sacramento County 1993).

Solano County

The following individual fire protection districts (FPDs) serve the unincorporated portion of Solano County: CAL FIRE, Gordon Valley Fire Station, Cordelia FPD, Dixon FPD (under contract with City of

Dixon Fire Department), East Vallejo FPD (under contract with City of Vallejo Fire District), Montezuma FPD, Ryer Island FPD (under contract with Montezuma FPD), Suisun FPD, and Vacaville FPD.

Sutter County

Law enforcement in Sutter County is provided by two principal separate agencies, the Sutter County Sheriff, and the California Highway Patrol. The Sutter County Sheriff's Department (SCSD) is responsible for crime prevention, law enforcement, and criminal investigation in the unincorporated areas of the county and the city of Live Oak. The SCSD has its main office at the Law Enforcement Center in Yuba City, with resident deputies in Meridian, Robbins, and Pleasant Grove. The existing county jail is also located at the Law Enforcement Center. The California Highway Patrol (CHP) is the primary law enforcement agency for state highways and roads in the unincorporated areas of the county. Services include law enforcement, traffic control, accident investigation, and management of hazardous materials spill incidents. The CHP has a mutual aid agreement with the Sheriff's Department and will respond when requested by the sheriff.

Sutter County Fire and Emergency Services coordinates fire protection for CSAs C, D, and F in the unincorporated portion of Sutter County covering approximately 360 square miles. In addition, Sutter County provides fire service to the city of Live Oak through a contractual agreement. The Meridian FPD covers approximately 93 square miles. The Sutter Basin FPD covers approximately 127 square miles. The Walton FPD covers approximately 24 square miles. The Meridian FPD, Sutter Basin FPD, and Walton FPD are all independent FPDs.

Tehama County

Law enforcement in the unincorporated areas of Tehama County and the City of Tehama is provided by the Tehama County Sheriff's Department, whose headquarters are located in Red Bluff. The cities of Red Bluff and Corning operate police departments with jurisdiction in the incorporated cities. The California Highway Patrol enforces traffic laws throughout the county with an office located at 2550 Main Street in Red Bluff.

The Tehama County Fire Department (TCFD) and CAL FIRE are integrated departments that mutually support each agency's fire suppression efforts without an agreement. The TCDF and CAL FIRE provide fire protection and other emergency services for the unincorporated areas of Tehama County, with the exceptions of the Gerber and Capay FPDs.

Yolo County

Fire protection services, including rescue, emergency medical services, hazardous material response, are provided by a large number of fire districts and the Rumsey Tribe within the unincorporated areas of Yolo County (Yolo County 2009). Law enforcement services in Yolo County are provided by the County Sheriff–Coroner. This department patrols the County, administers the County Jail and work program, provides animal control services, and serves as the County Coroner (Yolo County 2009).

Yuba County

The Yuba County Sheriff's Office provides dispatching services to the City of Wheatland, Plumas-Brophy Fire District, and Olivehurst Public Utilities District as well as to the City of Marysville Fire Department for calls that this department responds to outside city limits. Unincorporated areas of the county are provided with fire protection by nine fire districts, community services districts, or public utilities districts.

Fire protection in Yuba County is provided by several agencies, reflecting the fact that there is city, county, state, and generally administered land and privately owned land in the county. The two incorporated cities, Marysville and Wheatland, provide their own fire protection through the Marysville Fire Department and the Wheatland Fire Department.

The California Highway Patrol assists in moving vehicles and pedestrians from hazard areas; assists local law enforcement agencies in establishing evacuation routes and traffic control procedures; controls traffic on state freeways and highways within unincorporated areas of the state; and assists in preventing traffic from re-entering hazard areas.

Regulatory Setting

Appendix C, Regulatory Background, describes the state and local laws, regulations, and policies that pertain to utilities and public services within the program area. Specifically, the California Environmental Quality Act, California Public Utilities Commission standards, the California Integrated Waste Management Act, and local general plans are pertinent to the proposed program.

Determination of Effects

Assessment Methods

Effects on utilities and public services were evaluated based on the duration and extent to which such services would be affected as well as the ability of a service provider to continue to provide a level of service that could meet the needs of an affected community. This section analyzes proposed program effects that are not expected to create additional demand for electricity or natural gas and would not require the construction or expansion of electrical or natural gas transmission lines or public utilities. Implementation of the proposed program would not require the construction or expansion of wastewater treatment facilities, nor would it require the relocation of major infrastructure.

Significance Criteria

An effect pertaining to utilities and public services as a result of the proposed program would be considered significant if it would result in any of the following environmental effects.

- Require the construction or expansion of electrical or natural gas transmission or distribution facilities.

- Require the construction or expansion of a water conveyance or wastewater treatment facility or require new or expanded water supply entitlements.
- Require the construction of new or expanded stormwater drainage facilities.
- Require the construction or expansion of wastewater treatment facilities.
- Cause the capacity of a solid waste landfill to be reached sooner than it would without the proposed program.
- Require the construction or expansion of communications facilities (telephone, cell, cable, satellite dish).
- Adversely affect public utility facilities that are located underground or aboveground along the local roadways from program construction activities.
- Create an increased need for new fire protection, police protection, or ambulance services or adversely affect existing emergency response times or facilities.
- Intersect with major infrastructure components, such as bridges or overpasses, requiring relocation of the components.

The proposed program would not require the construction or expansion of electrical or natural gas transmission or distribution facilities, water conveyances, or wastewater treatment facilities; and would not require new or expanded water supply entitlements, stormwater drainage facilities, or wastewater treatment facilities. The proposed program would also not cause the capacity of a solid waste landfill to be reached sooner than it would without the program; would not require the construction or expansion of communications facilities; would not create an increased need for new fire protection, police protection, or ambulance services; and would not intersect with major infrastructure components. Therefore, the first six criteria and the last two criteria are not discussed further in this analysis.

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, regular operation and maintenance (O&M) of the levee system would continue as presently executed by the local maintaining entities (subject to revision of the governing O&M manual), but construction activities associated with the proposed program would not occur. As a result, erosion would continue and the risk of levee failure and possible catastrophic flooding would increase as more erosion sites become critical and repair is limited to emergency response by federal, state or local flood control agencies that would eventually implement bank protection along various sites along Sacramento River Flood Control Project levees through emergency action. The continued potential for levee failure could cause inundation from high flows and destruction or damage to utility lines and water or wastewater piping or facilities, all of which could lead to temporary power outages and interruptions of other utilities in the study area. The level of damage to public services and infrastructure is unpredictable, but could adversely affect fire protection, police protection, or emergency medical assistance. There would be no immediate effect on the utilities within the program area. Possible degradation of the existing levees could result in utility failure in extreme circumstances.

Alternative 2A—Low Maintenance

Effect PUB-1: Potential for Damage of Utility Infrastructure and Disruption of Service during Construction

Alternative 2A entails construction activities that could damage or require the relocation of existing utility infrastructure at individual project sites, including underground and overhead electrical distribution lines, aerial and underground telephone lines, underground natural gas pipelines, and underground cable television lines, and could cause temporary service interruptions. Because the potential exists for damage and service interruptions to existing utilities both identified and unidentified, this construction effect is considered potentially significant. However, implementation of Mitigation Measure PUB-MM-1 would reduce the severity of this effect to a level that is less than significant.

Mitigation Measure PUB-MM-1: Verify Utility Locations, Coordinate with Utility Providers, Prepare and Implement a Response Plan, and Conduct Worker Training

The following measures will be implemented to avoid and minimize potential damage to utilities and service disruptions during construction.

- Obtain utility excavation or encroachment permits as necessary before initiating any work with the potential to affect utility lines, and include all necessary permit terms in construction contract specifications.
- Before starting construction, coordinate with utility providers in the area to locate existing lines. Avoid the relocation of utilities when possible. Provide notification of potential interruptions in services to the appropriate agencies.
- Before starting construction, verify utility locations through field surveys and Underground Service Alert services. Clearly mark any buried utility lines in the area of construction before any earthmoving activity.
- Before starting construction, prepare a response plan to address potential accidental damage to a utility line. The plan will identify chain-of-command rules for notifying authorities and appropriate actions and responsibilities to ensure the safety of the public and the workers. Contractors will conduct worker training to respond to these situations.
- Stage utility relocations to minimize service interruptions.

Effect PUB-2: Potential Disruption to Irrigation Water Supply

Under Alternative 2A, placement of bank fill stone protection would be confined to the levee slope. There would be no expansion of the levee footprint, no acquisition of additional land, and construction would avoid areas where existing irrigation water supply facilities are located. There would be no effect on irrigation water supply.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect PUB-1: Potential for Damage of Utility Infrastructure and Disruption of Service during Construction

This effect would be similar to Alternative 2A in type and magnitude because construction activities under Alternative 3A could also damage or require the relocation of existing utility infrastructure at individual project sites, including underground and overhead electrical distribution lines, aerial and underground telephone lines, underground natural gas pipelines, and underground cable television lines, and could cause temporary service interruptions. Because the potential exists for damage and service interruptions to existing utilities both identified and unidentified, effect PUB-1 is considered potentially significant. However, implementation of Mitigation Measure PUB-MM-1 would reduce the severity of this effect to a level that is less than significant.

Effect PUB-2: Potential Disruption to Irrigation Water Supply

Under Alternative 3A, improvements would result in the construction of a setback levee some distance from the existing levee, or construction of an adjacent levee, resulting in a widened landside footprint. Although it cannot be known at this time precisely how far landward the footprint would extend for the flood control facilities under this alternative, a comparatively greater extent of land would be displaced by these improvements than under Alternative 2A, increasing the potential for effects to irrigation and drainage pipelines, wells, and pumps.

As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 linear feet (LF) in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed.

Although temporary, the potential for substantial interruptions of irrigation supply could occur if irrigation infrastructure is damaged or otherwise rendered inoperable at a time when it is needed (e.g., by the time crop irrigation must begin). Because construction activities could cause a delay in the provision of irrigation supply, this temporary effect is considered significant. However, implementation of Mitigation Measure PUB-MM-2 would reduce the potential temporary effect of disruptions to irrigation supply to a level that is less than significant.

Mitigation Measure PUB-MM-2: Coordinate with Irrigation Water Users Before and During Infrastructure Modifications and Minimize Disruptions to Supply

The Corps and its contractors for engineering design and construction will implement the following measures to minimize the potential for irrigation water supply interruptions during construction activities.

- Determine if construction activities will modify or otherwise effect irrigation supply infrastructure.
- Coordinate the timing of all modifications to irrigation supply infrastructure with the affected infrastructure owners and water supply users.

- Include detailed scheduling of modifications or replacement of existing irrigation infrastructure components in project design and in construction plans and specifications.
- Plan and complete modifications of irrigation infrastructure for the non-irrigation season to the extent feasible.
- If necessary, provide for alternative water supply when modifications or replacement of irrigation infrastructure must be conducted during periods when it would be in normal use by an irrigation water user.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect PUB-1: Potential for Damage of Utility Infrastructure and Disruption of Service during Construction

This effect would be similar to that described under Alternative 2A in type and magnitude. Implementation of Mitigation Measure PUB-MM-1 would reduce the severity of this effect to a level that is less than significant.

Effect PUB-2: Potential Disruption to Irrigation Water Supply

This effect would be similar to that described under Alternative 3A, but at a lesser magnitude because fewer setback levees and adjacent levees would be constructed. Construction activities could cause a delay in the provision of irrigation supply, and this temporary effect would be considered significant. Implementation of Mitigation Measure PUB-MM-2 would reduce this effect to a level that is less than significant.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect PUB-1: Potential for Damage of Utility Infrastructure and Disruption of Service during Construction

This effect would be similar to that described under Alternative 2A in type and magnitude. Implementation of Mitigation Measure PUB-MM-1 would reduce the severity of this effect to a level that is less than significant.

Effect PUB-2: Potential Disruption to Irrigation Water Supply

This effect would be similar to that described under Alternative 3A, but at a lesser magnitude because fewer setback levees and adjacent levees would be constructed. Construction activities could cause a delay in the provision of irrigation supply, and this temporary effect would be considered significant. Implementation of Mitigation Measure PUB-MM-2 would reduce this effect to a level that is less than significant.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effects associated with Alternative 6A would be comparable in type and magnitude to those described for Alternative 3A because construction activities under Alternative 6A could also damage or require the relocation of existing utility infrastructure at individual project sites, including underground and overhead electrical distribution lines, aerial and underground telephone lines, underground natural gas pipelines, and underground cable television lines, and could cause temporary service interruptions. In addition, irrigation water supply could be disrupted in areas where setback levees are constructed. Because the potential exists for damage and service interruptions to existing utilities both identified and unidentified, both effects PUB-1 and PUB-2 are considered potentially significant. However, implementation of Mitigation Measures PUB-MM-1 and PUB-MM-2 would reduce the severity of these effects to a level that is less than significant.

Chapter 17
Aesthetics

Introduction and Summary

This chapter describes the environmental setting associated with aesthetics, the determination of the environmental effects on aesthetics that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- Google Earth and Maps Street View (2009).
- American River Parkway Plan (Sacramento County 2008).
- California Scenic Highway Program (California Department of Transportation 2009, 2007).
- Final Alternatives Report—80,000 LF (107 Sites), Sacramento River Bank Protection Project (Kleinfelder-Geomatrix 2009).
- Programmatic Biological Assessment for the Sacramento River Bank Protection Project Phase II, Final (Stillwater Sciences 2007).

Table 17-1 summarizes the aesthetics effects resulting from the implementation of the proposed program.

Table 17-1. Summary of Aesthetics Effects and Mitigation

Effect	Mitigation Measure	Implementation Period
VIS-1: Temporary Visual Effects Caused by Construction Activities	VIS-MM-1: Install Temporary Visual Barriers between Construction Zones and Residences and Maintain Construction Sites and Staging Areas in an Orderly Fashion	During construction
VIS-2: Substantially Adversely Affect a Scenic Vista	None available	Not applicable
VIS-3: Substantially Damage Scenic Resources, including, but Not Limited to, Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway	None available	Not applicable
VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings	None available	Not applicable
VIS-5: Create a New Source of Light or Glare	None available	Not applicable

Environmental Setting

This section discusses the existing conditions related to aesthetics in the program area.

Concepts and Terminology

Identifying a project area's aesthetics and conditions involves three steps.

1. Objective identification of the visual features (aesthetics) of the landscape.
2. Assessment of the character and quality of those resources relative to overall regional visual character.
3. Determination of the importance to people, or sensitivity, of views of aesthetics in the landscape.

A combined methodology approach using Federal Highway Administration, U.S. Bureau of Land Management, U.S. Forest Service, and professional standards of visual assessment methodology has been used to determine potential effects on aesthetic values of the program area. The aesthetic value of an area is a measure of its visual character and quality, combined with the viewer response to the area (Federal Highway Administration 1988). Scenic quality can best be described as the overall impression that an individual viewer retains after driving through, walking through, or flying over an area (U.S. Bureau of Land Management 1980). Viewer response is a combination of viewer exposure and viewer sensitivity. Viewer exposure is a function of the number of viewers, number of views seen, distance of the viewers, and viewing duration. Viewer sensitivity relates to the extent of the public's concern for a particular viewshed. These terms and criteria are described in detail below.

Visual Character

Natural and artificial landscape features contribute to the visual character of an area or view. Visual character is influenced by geologic, hydrologic, botanical, wildlife, recreational, and urban features. Urban features include those associated with landscape settlements and development, including roads, utilities, structures, earthworks, and the results of other human activities. The perception of visual character can vary significantly seasonally, even hourly, as weather, light, shadow, and elements that compose the viewshed change. The basic components used to describe visual character for most visual assessments are the elements of form, line, color, and texture of the landscape features (U.S. Forest Service 1995; Federal Highway Administration 1988). The appearance of the landscape is described in terms of the dominance of each of these components.

Visual Quality

Visual quality is evaluated using the well-established approach to visual analysis adopted by Federal Highway Administration, employing the concepts of vividness, intactness, and unity (Federal Highway Administration 1988; Jones et. al. 1975), which are described below.

- **Vividness** is the visual power or memorability of landscape components as they combine in striking and distinctive visual patterns.
- **Intactness** is the visual integrity of the natural and human-built landscape and its freedom from encroaching elements; this factor can be present in well-kept urban and rural landscapes, and in natural settings.

- **Unity** is the visual coherence and compositional harmony of the landscape considered as a whole; it frequently attests to the careful design of individual components in the landscape.

Visual quality is evaluated based on the relative degree of vividness, intactness, and unity, as modified by its visual sensitivity. High-quality views are highly vivid, relatively intact, and exhibit a high degree of visual unity. Low-quality views lack vividness, are not visually intact, and possess a low degree of visual unity.

Viewer Exposure and Sensitivity

The measure of the quality of a view must be tempered by the overall sensitivity of the viewer. Viewer sensitivity or concern is based on the visibility of resources in the landscape, proximity of viewers to the visual resource, elevation of viewers relative to the visual resource, frequency and duration of views, number of viewers, and type and expectations of individuals and viewer groups.

The importance of a view is related in part to the position of the viewer to the resource; therefore, visibility and visual dominance of landscape elements depend on their placement within the viewshed. A viewshed is defined as all of the surface area visible from a particular location (e.g., an overlook) or sequence of locations (e.g., a roadway or trail) (Federal Highway Administration 1988).

To identify the importance of views of a resource, a viewshed must be broken into distance zones of foreground, middleground, and background. Generally, the closer a resource is to the viewer, the more dominant it is and the greater its importance to the viewer. Although distance zones in a viewshed may vary between different geographic regions or types of terrain, the standard foreground zone is 0.25–0.5 mile from the viewer, the middleground zone is from the foreground zone to 3–5 miles from the viewer, and the background zone is from the middleground to infinity (U.S. Forest Service 1995).

Visual sensitivity depends on the number and type of viewers and the frequency and duration of views. Visual sensitivity is also modified by viewer activity, awareness, and visual expectations in relation to the number of viewers and viewing duration. For example, visual sensitivity is generally higher for views seen by people who are driving for pleasure, people engaging in recreational activities such as hiking, biking, or camping, and homeowners.

Sensitivity tends to be lower for views seen by people driving to and from work or as part of their work (U.S. Forest Service 1995; Federal Highway Administration 1988; U.S. Soil Conservation Service 1978). Commuters and nonrecreational travelers typically have fleeting views and tend to focus on commute traffic, not on surrounding scenery; therefore, they are generally considered to have low visual sensitivity. Residential viewers typically have extended viewing periods and are concerned about changes in the views from their homes; therefore, they are generally considered to have high visual sensitivity. Viewers using recreation trails and areas, scenic highways, and scenic overlooks are usually assessed as having high visual sensitivity.

Judgments of visual quality and viewer response must be made with a regional frame of reference (U.S. Soil Conservation Service 1978). The same landform or visual resource appearing in different geographic areas could have a different degree of visual quality and sensitivity in each setting. For example, a small hill may be a significant visual element on a flat landscape but have very little significance in mountainous terrain.

Existing Conditions

Visual Character of the Program Area

The program area is located in the region of California's Sacramento Valley (valley), with its northern extent beginning at the town of Gerber (approximately 25 miles north of Chico) stretching south to the shores opposite Sherman Island in the Sacramento–San Joaquin Delta, 3 miles east of Collinsville. The metropolitan area of Sacramento serves as the region's urban core, connected to smaller cities, such as Chico, Yuba City, West Sacramento, Davis, and Elk Grove, by major roadways in the region. While much of the valley is still in agricultural production, there has been and continues to be a conversion of agricultural land to urban and suburban land uses. This trend is evident around the outskirts of Chico, Yuba City, Davis, Sacramento, West Sacramento, and Elk Grove. Many of the small, agrarian communities in this region, such as Live Oak, Colusa, Woodland, and Rio Vista, are experiencing similar growth.

Agricultural land, planted predominantly with row crops, stretches for miles in the region. A patchwork of fields separates the urban center of Sacramento, and its suburban outskirts, from smaller, outlying cities. These fields offer expansive views that, when haze is at a minimum, extend over agricultural fields and recent development in the foreground to the middleground and background. The high-rise buildings of downtown Sacramento can be seen in the middleground and background, rising up from the flat valley floor. Background views to the Sierra Nevada foothills are more rarely seen to the east while views of Mount Vaca and the Coast Range, to the west, and the Sutter Buttes, west of Yuba City, are more commonly seen. These types of landscape views are strongly characteristic of the valley and have contributed to the program area's identity.

Growth radiating out from city and town cores is reducing the amount of agricultural land in the region and closing the gap between the Sacramento metropolitan area and smaller, outlying cities and towns. Waterways, both natural and human made, and bypasses often aid in limiting development but are a desirable amenity that, combined with increased access provided via new roadway facilities, lead to development spreading outward where vast acreage of agricultural land remains. This growth is changing the visual character from rural to suburban.

Development of the smaller cities in the region is typified by a growing core of residential, commercial, and some industrial land uses with agricultural fields surrounding the city outskirts. Older residential and commercial areas in the region are often distinct, having a wide vernacular of architectural styles, development layouts, and visual interest. Newer residential and commercial development, however, tends to be homogenous in nature, having similar architectural styles, building materials, plan layouts, and commercial entities; and development often lacks a distinctive character from one city to the next.

Overall, a mix of developed and natural landscapes characterizes the program area. The landscape pattern is influenced by development sprawling from existing city cores and the major roadways in the program area. The waterways and areas within each of the four regions of the program area have different visual characteristics at a finer scale. In general, waterways within each region tend to be visually analogous and are discussed as such for the purpose of this analysis. However, areas that visually deviate from the general visual character are identified and discussed. Viewers in all regions include residents, businesses, roadway users, and recreational users. Areas to be affected by the proposed program are shown in Figure 2-1.

Region 1a

This region's primary features are the Yolo, Willow Slough, and Ulatis Creek Bypasses; Cache and Putah Creeks; and several sloughs in the Delta. The agricultural fields of the Yolo Bypass become inundated with water during periods of high flows in the program area. Buildings associated with farms and duck clubs are commonly raised structures that are scattered throughout the bypass. Most of the Yolo Bypass is kept free of shrubs and trees, except along the toe drains adjacent to the levees, where riparian vegetation lines the water corridor. The Willow Slough and Ulatis Creek Bypasses are much smaller, similar to canals, are highly channelized, and have levees on either side with grassy side slopes.

Cache Creek in the program area has a wider floodplain with gravel bars and riparian vegetation to the west, with past and present mining activities located to the north and south. East of the mining areas, its floodplain narrows and is more channelized on approach to Interstate 5, with thin bands of riparian vegetation, and continues in a confined corridor until it reaches the Cache Creek Settling Basin where sediment from mining activities carried during the high flows of Cache Creek can settle out before entering the Sacramento River.

Putah Creek, in the program area, has a narrow and densely vegetated corridor until it passes under Interstate 80, where the levees transition to a farther setback that more than doubles the width of available floodplain as it enters the Yolo Bypass. However, much of this is an elevated floodplain that is being used for agricultural production. This is possible because the Putah Creek does not generally flood outside of the narrow, dense riparian corridor that has steep banks up to the elevated floodplain. Sloughs are highly channelized by levees on both sides of the waterways. Vegetation along the levees varies from a thick, to narrow band of riparian and upland vegetation to grassy slopes. These waterways are often highly armored with riprap with minimal vegetation growing above the rock line, as reported in the programmatic biological assessment (BA) (Stillwater Sciences 2007) and further discussed in Chapter 10, Vegetation and Wetlands.

Delta sloughs meander through a patchwork of agricultural fields and orchards, passing by several small water-oriented communities, on their flow toward the Suisun Marsh. The network of sloughs form dendritic channel patterns that wind and branch through the low-lying landscape and create agricultural islands. Many of these channels are contained by the low levees that have contributed to maintaining historical channel patterns. Human-made irrigation channels have been created to transport water from the sloughs to the fields. Development in this Delta area occurs alongside the sloughs where roadways such as State Route (SR) 160 (River Road/Victory Highway) and other paved local roadways on levees provide access.

Foreground views in the Yolo Bypass typically consist of agricultural fields, the toe drains, and levees, dependent upon location within the landscape. Roadways, typically found on levees or adjacent to levees in this region, provide most of the views toward the program area. Foreground views near smaller bypasses, creeks, and sloughs often consist of the waterway and levees, vegetation, surrounding agriculture and orchards, communities, docking areas, local roadways, and related infrastructure. Middleground and background views throughout the region may be limited by vegetation, levees, and infrastructure or may extend over the landscape to include views of the Sacramento city skyline, the Sierra Nevada, the Coast Range, and a collage of agricultural fields and orchards.

Region 1b

This region's primary features are the Sacramento and American Rivers and canals. The Sacramento River in this region meanders along a path that is highly confined by levees. Vegetation within the river corridor is limited to a thin band that varies in density from only grassy banks with a few shrubs to densely vegetated, as reported in the programmatic BA (Stillwater Sciences 2007) and further discussed in Chapter 10, Vegetation and Wetlands. The American River is allowed to meander a little more freely within its levees, creating bars and banks that are often highly vegetated with mature riparian vegetation. This floodplain is highly used as an open space corridor supporting habitat, wildlife, and recreational uses. The American River in this region, often identified as the Lower American River, is both a federally and state-designated Wild and Scenic River classified as "recreation" (see Appendix C, Regulatory Background).

The waterways in this region of the program area meander through a patchwork of agricultural fields and orchards, passing by the urban areas of West Sacramento and Sacramento, on their flow toward the Delta. Roadways, typically found on levees or adjacent to levees in this region, provide most of the views toward the program area. Foreground views along the rivers often consist of the waterway and levees, vegetation, surrounding agriculture and orchards, development and communities, docking areas, local roadways, and related infrastructure. Middleground and background views, throughout the region, may be limited by vegetation, levees, and infrastructure or may extend over the landscape to include views of the Sacramento skyline, Sierra Nevada Mountains, Coast Range, and a collage of agricultural fields and orchards.

Region 2

This region's primary features are the Sacramento, Feather, Yuba, and Bear Rivers; the Sutter Bypass; the Colusa Main Drain; Butte and Honcut Creeks; and several smaller bypasses and canals. The Sacramento River in this region is highly confined by levees on both sides of the river as it meanders through a patchwork of agricultural fields and orchards. Vegetation along the levees varies from a dense yet narrow band of riparian and upland vegetation to grassy slopes, as reported in the programmatic BA (Stillwater Sciences 2007) and further discussed in Chapter 10, Vegetation and Wetlands.

Between Grimes and Sycamore, a portion of the Sacramento River has a wider, vegetated floodplain where the river is allowed to meander more freely. The Sutter Bypass hugs the base of the Sutter Buttes, where the bypass begins in the north, and becomes a broad corridor paralleling the Sacramento River with large straight segments and shallow bends as it travels south. The Tisdale Bypass and its vegetated low-flow channels allow the Sacramento River to flow into the Sutter Bypass in Region 2. The Sutter Bypass widens near Knights Landing as the bypass travels south and serves as a water bypass structure that supports agricultural production outside of the winter and early spring months when flows are high, inundating this area and forming a large water body. The Colusa Bypass's grassy bottom, showing evidence of scarring caused by flows, provides a visual contrast between the character of Region 2 and Region 3.

The Feather River in the program area has a wider floodplain with gravel bars and riparian vegetation to the north, and past mining activities located to the east and west. South of the mining areas, the river's floodplain expands and contracts. In narrower areas it supports a dense riparian vegetation corridor. In wider areas there is an elevated floodplain that is being used for agricultural production, which often extends to bends in the river. This character remains much the same until the river enters the Sutter Bypass, where it hugs the Garden Highway on the east, has only a narrow band of riparian vegetation on either side, and has a wide swath of agricultural fields between it and the west levee.

The Yuba River has a wider floodplain with many gravel bars and narrow areas of riparian vegetation influenced by intense past mining activities located to the northeast. The Bear River has thin bands of riparian vegetation on either side. The river is allowed to meander within the narrow floodplain and within the confined corridor created by the levees. Creeks and canals in this region are highly channelized by levees on both sides of the waterways. Vegetation along the levees varies from a dense yet thin band of riparian vegetation to grassy slopes.

The waterways in this region of the program area meander through a patchwork of agricultural fields and orchards, passing by several smaller and larger rural communities as the rivers flow toward the south. Roadways, typically found on levees or adjacent to levees in this region, provide most of the views toward the program area. Foreground views near the creeks and river often consist of the waterway, levees, vegetation, surrounding agriculture, orchards, communities, docking areas, local roadways, and related infrastructure. Middleground and background views throughout the region may be limited by vegetation, levees, and infrastructure or may extend over the landscape to include views of the Sutter Buttes, the Sierra Nevada, the Coast Range, and a collage of agricultural fields and orchards.

Region 3

This region's primary features are the Sacramento River and Elder, Deer, and Mud Creeks. Colusa marks a distinct visual change for the Sacramento River from lower regions. At Arnold Bend, west of Bridge Street/River Road, the Sacramento River transforms from a highly channelized system to a meandering river corridor with many bends, depositional bars, and dense riparian vegetation. The creeks are also not highly channelized in this region and have wider floodplains, gravel bars and sand bars, and densely vegetated corridors, as reported in the programmatic BA (Stillwater Sciences 2007) and further discussed in Chapter 10, Vegetation and Wetlands.

The waterways in this region of the program area meander through a patchwork of agricultural fields and orchards, passing by several small rural communities, as the waterways flow south. Roadways, typically found on levees or adjacent to levees in this region, provide most of the views toward the program area. Foreground views near the creeks and river often consist of the waterway, levees, vegetation, surrounding agriculture, orchards, communities, docking areas, local roadways, and related infrastructure. Middleground and background views throughout the region may be limited by vegetation, levees, and infrastructure or may extend over the landscape to include views of the Sutter Buttes, the Sierra Nevada, the Coast Range, adjacent wildlife refuges, and a collage of agricultural fields and orchards.

Existing Viewer Groups and Viewer Responses

The primary viewer groups in the program area are persons living or conducting business near levees; travelers using the interstates, highways, and smaller local roads (including those on levee crowns); and recreational users (including boaters, beachgoers, and anglers using canals, creeks, and rivers; trail users; equestrians; bicyclists; and joggers). All viewer groups have direct views of the program regions described above.

Residents

Suburban and rural residents are located directly adjacent to levees or are separated from them by local streets or a similar corridor. Suburban residences are mostly oriented inward toward the developments, and only residences on the outer edge of the developments have middleground and background views of levees, vegetation, and trees. The separation and orientation of rural residences allow inhabitants to have direct views over agricultural fields toward levees. Both suburban and rural residents are likely to have a high sense of ownership over their adjacent waterways, the open space that surrounds them, the recreational opportunities they provide, and their inherent scenic quality. Residents are considered to have high sensitivity to changes in the viewshed because of their potential exposure to such views, short distance from the program areas, and sense of ownership.

Businesses

Viewers from industrial, commercial, government, and educational facilities have semi-permanent views from their respective facilities. Situated in different locations throughout the program area, these facilities' views range from views limited by the levees to sweeping views that extend out to the background. Employees and users of these facilities are likely to be occupied with their work activities and tasks at hand. However, some of these facilities are dependent on the waterways in the program area as a destination spot and source of income (e.g., the Port of West Sacramento and restaurants situated along the river).

People using these facilities often travel to and from work and spend leisure time on the waterways and levees. Because of their limited viewing times, their focus on tasks at hand, and the current use of the levees, this viewer group is considered to have moderate sensitivity to changes in views.

Roadway Users

Roadway users' vantages differ based on the roadway they are traveling and the elevation of that roadway. The majority of views are mostly limited to the foreground by suburban, commercial, and industrial development; vegetation; and the levees themselves. Views to the middleground and background are present but are limited to areas where structures that otherwise would conceal background views from the roadway are set back. However, if the vantage is elevated, as on portions of Capital City Freeway, bridges crossing over the Sacramento River, levee roads (e.g., SR 160), and other local roadways, most views of the surrounding mountain ranges (Vaca Mountains, Coast Range, and Sierra Nevada), waterways (American and Sacramento Rivers, Yolo Bypass when flooded), and open space areas (agriculture, parkways) are only partially obstructed by the rooflines and mature vegetation in the area.

Travelers use roadways at varying speeds; normal highway and roadway speeds differ based on speed limits and the traveler's familiarity with the route and roadway conditions (e.g., presence/absence of rain). Single views typically are of short duration, except on straighter stretches where views last slightly longer. Viewers who frequently travel these routes generally possess moderate visual sensitivity to their surroundings. The passing landscape becomes familiar to these viewers, and their attention typically is not focused on the passing views but on the roadway, roadway signs, and surrounding traffic. Viewers who travel local routes for their scenic quality generally possess a higher visual sensitivity to their surroundings because they are likely to respond to the natural environment with a high regard and as a holistic visual experience.

Furthermore, scenic stretches of roadway passing through the program area offer sweeping views of the surrounding area that are of interest to motorists, especially when traveling on the bridges or levee tops. For these reasons, viewer sensitivity is moderate among most roadway travelers.

Recreational Users

Recreational users view the program areas from parks, waterways, roadways, trails, and the levees themselves. Recreational uses consist of boating and fishing, hunting along the upper Sacramento River and rural levees, birding, walking, running, jogging, and bicycling along trails, levee crowns, and local roads. Users of the waterways are likely to seek out natural areas within the corridor, such as sand and gravel bars and beaches, in addition to using the waterways as a resource. Waterway users provide differing views based on their location in the landscape and are accustomed to variations in the level of industrial, commercial, suburban, and recreational activities occurring within the program area. The amount of vegetation present along the levees creates a softened, natural edge that is enjoyed by all recreational users. Local recreational users also have a high sense of ownership over the waterways and corridors they use, and these areas are highly valued throughout the Sacramento Valley area.

Viewer sensitivity is high among recreational users using the program areas because they are more likely to highly value the natural environment, appreciate the visual experience, have a high sense of ownership, and be more sensitive to changes in views. Refer to Chapter 14, Recreation, for a discussion of impacts on Sacramento River recreation.

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, and local laws, regulations, and policies that pertain to aesthetic resources within the program area. Pertinent laws, regulations, policies, and plans are listed below.

- Federal:
  - National Environmental Policy Act
  - Wild and Scenic Rivers Preservation Act
- State:
  - California Environmental Quality Act
  - California Wild and Scenic Rivers
  - California Scenic Highway Program
- Local:
  - American River Parkway Plan
  - Other local ordinances and policies

Determination of Effects

This section describes the effect analysis relating to aesthetics for the proposed program. It describes the methods used to determine the effects of the proposed program and lists the thresholds used to conclude whether an effect would be significant. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant effects accompany each effect discussion.

Assessment Methods

Changes to the visual environment are assessed by factoring the degree of change to the visual resource affected and viewer response to that change. Using the concepts and terminology described at the beginning of this section, and criteria for determining effects, analysis of visual effects of the proposed program are based on:

- Observation of existing visual resources from available roadways using Google Maps Street View.
- Observation of landscape patterns using Google Earth.
- Review of the proposed program in regard to compliance with state and local ordinances and regulations and professional standards pertaining to visual quality.

The Corps has published a Visual Resources Assessment Procedure (VRAP) (Environmental Laboratory 88-1) for determining the visual resource effects of water resource projects, but the VRAP was not used in this analysis because the VRAP is heavily dependent on site-specific detail, which is not necessarily meaningful at a programmatic level. However, the assessment methodology and terminology used for this analysis is very similar to the VRAP. Both involve the following steps:

- Establishment of a baseline that describes the existing character and quality of visual resources;
- Assessment of visual resource effects that would occur as a result of the proposed program;
- Evaluation of the beneficial or adverse nature of the visual effects; and
- Recommendation of changes in design or mitigation measures to lessen adverse visual effects.

The methodology utilized for this analysis is robust and provides a sound means of analyzing impacts under NEPA and CEQA.

Significance Criteria

For this analysis, an effect pertaining to aesthetics was considered significant if it would result in any of the following environmental effects, which are based on professional practice and State CEQA Guidelines Appendix G (14 California Code of Regulations Sections 15000 et seq.):

- Cause a substantial, demonstrable negative aesthetic effect on a scenic vista or view open to the public.
- Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway.
- Substantially degrade the existing visual character or quality of the site and its surroundings.

- Create a new source of substantial light or glare that would adversely affect day or nighttime public views.

Professional Standards

Professional standards result from professional and direct expertise gained by staff working on visual analyses and consulting with other experienced staff, subconsultants, and clients on visual effects, including knowledge gained from public input on a broad range of projects. The effects listed represent collective knowledge that is professionally agreed upon and represents common, general public concerns. According to professional standards, a project may be considered to have a significant effect if it would substantially:

- Conflict with local guidelines or goals related to visual quality.
- Alter the existing natural viewsheds, including changes in natural terrain.
- Alter the existing visual quality of the region or eliminate visual resources.
- Increase light and glare in the project vicinity.
- Result in backscatter light into the nighttime sky.
- Result in a reduction of sunlight or introduction of shadows in community areas.
- Obstruct or permanently reduce visually important features.
- Result in long-term (that is, persisting for 2 years or more) adverse visual changes or contrasts to the existing landscape as viewed from areas with high visual sensitivity.

The proposed program would not result in backscatter light into the nighttime sky, and would not result in a reduction of sunlight or introduction of shadows in community areas. Therefore, the fifth and sixth standards are not discussed further in this analysis.

Effects and Mitigation Measures

Alternative 1—No Action

Without the proposed program, aesthetics are expected to remain similar to existing conditions. The visual character could change in the event of levee failure during flooding. Catastrophic flooding has the potential to destroy vegetation, infrastructure, and development. However, current policy under the Corps' Rehabilitation and Inspection Program is to protect eroding sites during emergencies and to rehabilitate and repair Public Law 84-99 eligible (active status) levees that are damaged during flood events. Erosion on banks often has the potential to create situations where there are small earthslides that take vegetation with them. However, this is part of a natural functioning river system and vegetation more often than not will re-colonize such sites over time. These areas often create areas of visual interest, but at erosion sites that are roughly 500 feet or larger, the loss of bank and vegetation due to erosion would be highly visible. Such a large site is likely to fall under emergency repair and be rocked, and unlikely to be evaluated for vegetative and instream woody material (IWM) environmental compensation.

Alternative 2A—Low Maintenance

Effect VIS-1: Temporary Visual Effects Caused by Construction Activities

Construction under this alternative would create temporary and permanent changes in views of and from the program area. Construction activities would require staging and the use of considerable heavy equipment and associated vehicles, including dozers, graders, cranes, scrapers, and trucks, adversely affecting views of adjacent residents, recreational users, motorists, and businesses. The equipment would be visible throughout the construction season. Presence of the equipment would temporarily degrade the visual quality of the program area. However, because this effect is temporary, would last no longer than the construction duration, and is limited to small portions of the larger river corridor, it would not substantially degrade the visual quality of the program area.

Residential viewer groups in the program area and vicinity are not accustomed to seeing construction activities and equipment, and sensitivity to such effects would be high. Recreational users would have scenic views disrupted during construction while visiting areas that are often appreciated for their high scenic qualities. Effects on roadway users would be significant because many local roadways are located on the levees in the program area.

In addition to the presence of construction equipment, construction of the levee embankment would require the removal of all vegetation within the construction footprint. All vegetation within 15 feet of the waterside toe would be removed during construction, in addition to the vegetation that would be removed for construction access and staging. The removal of mature landscape and native trees will substantially change the aesthetic qualities of the area. This effect would be significant.

As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed. Where construction areas are located in proximity to residences, Mitigation Measure VIS-MM-1 may be implemented to help mitigate the effect of the presence of construction equipment and staging areas on residential viewers. However, even with the potential implementation of Mitigation Measure VIS-MM-1, construction activities and the removal of vegetation would be a significant and unavoidable effect on all viewer groups. Under Alternative 2A, trees and other vegetation cannot be replanted to reduce the severity of this short- and long-term effect.

Mitigation Measure VIS-MM-1: Install Temporary Visual Barriers between Construction Zones and Residences and Maintain Construction Sites and Staging Areas in an Orderly Fashion

To obstruct undesirable views of construction activities from residence backyards and front yards that abut the project sites, the program proponent or the contractor may install fencing (such as chain link with slats or fencing made of windscreen material) or other structures. The fencing would be a minimum of 7 feet high to help maintain residents' privacy. In addition, construction sites and staging areas will be maintained in a neat and orderly fashion. The construction sites and staging areas will also be managed to be kept free of debris and trash to the degree possible. The construction sites and staging areas will be left in a clean state upon completion of construction.

Effect VIS-2: Substantially Adversely Affect a Scenic Vista

The program area is filled with scenic vistas. Major roads traversing the program area act as gateways and offer unique vistas of the contrasting landscape features. Development and the high-rise buildings of West Sacramento and Sacramento that tower over agricultural fields are softened by the lush riparian corridors that line the waterways. Vistas from the waterways are mostly not present because the levees and, in places, development, preclude views beyond the water channel. The majority of locations in Regions 1a, 1b, and 2 would require removal of all vegetation within 15 feet of the levee toe. Some locations within those regions and most locations in Region 3 have areas where vegetation beyond a 15-foot vegetation-free zone (VFZ) would be allowed to remain and/or have space to support vegetative and IWM environmental compensation. Removal of vegetation within 15 feet of the levee toe would open up additional vistas from levee roadways and vantages adjacent to erosion sites. Removal of vegetation at erosion sites, as perceived from vantages outside the program area, would not be very noticeable because bank erosion sites would be scattered within the program area and actions would take place over time, starting with erosion sites determined to be most critical. According to the 2009 80,000 LF Final Alternatives Report prepared by Kleinfelder-Geomatrix, the lengthiest site is 8,500 feet (1.6 miles) and the majority are less than 2,000 feet (0.4 mile) (Kleinfelder-Geomatrix 2009). Changes at the erosion sites from vantages outside the program area would not be very noticeable due to distance from the program area, length of erosion sites, and existing gaps that presently exist. Therefore, the proposed program would have a less-than-significant effect on scenic vistas.

Effect VIS-3: Substantially Damage Scenic Resources, including, but Not Limited to, Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway

SR 160 is a state-designated scenic highway and is located within Regions 1a and 1b. Table 17-2 lists erosion sites identified in the survey of erosion sites along the Sacramento River that would affect scenic views from SR 160. The erosion sites at river mile (RM) 35.3R and 35.4R would not be visible from SR 160 where the roadway deviates from the river's edge and travels through orchards.

Table 17-2. Erosion Sites and Lengths along the Sacramento River and SR 160

Region	Site	Length (feet)
Region 1a	RM 21.5L	159
Region 1b	RM 22.5L	852
	RM 22.7L	311
	RM 23.2L	589
	RM 23.3L	256
	RM 24.8L	781
	RM 25.2L	304
	RM 31.6R	442
	RM 38.5R	360

RM = river mile
Source: U.S. Army Corps of Engineers 2009, Appendix D

Removal of all vegetation within the levee footprint and 15 feet of the levee toe constitutes a drastic change to the vegetation and scenic resources, particularly large trees, along the roadway corridor. While vegetation beyond a 15-foot VFZ would be allowed to remain, the majority, if not all, of the erosion sites where the proposed program would affect views from SR 160 do not have such areas and would result in complete vegetation removal at erosion site. This complete removal would create and/or help to expand contrast sharply from the existing visual landscape and degrade the quality of views from SR 160. Similar effects are likely to result in counties in the program area that have designated scenic routes. Therefore, the proposed program would have a significant and unavoidable effect on scenic resources along designated scenic highways. There is no available mitigation. This effect occurs for a state-designated scenic highway in Regions 1a and 1b. This effect may also occur along county-designated scenic routes, which would be identified during project-level analysis, for all regions.

Effect VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings

Major roads through the program area are aligned on levee tops, cross over affected waterways, or are in sufficiently close proximity to have views of the program area. Residential and commercial developments also often have direct views of the program area. Lush riparian corridors that line the waterways soften the appearance of development and the high-rise buildings of West Sacramento and Sacramento that tower over agricultural fields.

The lower American River in Region 1b is a federal- and state-designated Wild and Scenic River classified as “recreation”. There is one erosion site at RM 7.3 that is 426 feet long (U.S. Army Corps of Engineers 2009). The erosion site survey states that erosion at this site is minor and may not need repair unless the levee crest is widened. Therefore, it is likely that there would be no effect or minor visual alterations on the designated waterway. Removal of all vegetation within the levee footprint and 15 feet of the levee toe constitutes a drastic visual change at these locations. While vegetation beyond a 15-foot VFZ would be allowed to remain, the majority of waterways in the program area do not have such areas and complete vegetation removal at these erosion sites would result. Even in areas where there is adequate area to support vegetative and IWM environmental compensation, complete vegetation removal would still occur on the levee slope and within 15 feet of the levee toe at erosion sites. This complete removal would contrast sharply with the existing visual landscape, alter the visual character from one that is vegetated with large trees and shrubs to one that is rocked and grassed, and degrade the overall visual quality. These changes in views would be perceived by all viewer groups. Therefore, the proposed program would have a long-term significant and unavoidable effect on the existing visual character and quality of the site and its surroundings. There is no available mitigation.

Effect VIS-5: Create a New Source of Light or Glare

The proposed program will not add any new sources of light. Removal of trees and shrubs and replacement with rock and grass would be visible on the landside and waterside of the levees to all adjacent viewer groups. This would increase glare by removing trees that are green in the spring and summer, when grass is brown, and remove shade that helps decrease glare on levee, roadway, and water surfaces. The change would also affect glare in the winter months to a slightly lesser degree because, while surfaces are not shaded as much when trees have lost their leaves, the sun is generally less intense and is at a lower angle during this time of year, and daylight hours are shorter. This effect would be significant to all viewer groups in direct contact (i.e., travelers on levee roadways, adjacent residents and business, and recreational users of waterways and levees) with locations affected by the proposed program. This effect would be significant and unavoidable. There is no available mitigation.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect VIS-1: Temporary Visual Effects Caused by Construction Activities

This effect would the same as under Alternative 2A. In addition, construction of a new setback levee adjacent to the existing levee could require the displacement and demolition of residences and businesses and alter roadway alignments. Displacement would heighten sensitivity among residence and business viewer groups by physically removing select viewers from their existing vantage points and relocating them. This displacement would cause highly negative perceptions for the remaining neighboring viewers.

Construction of an adjacent levee using the existing levee would likely displace agricultural fields, orchards, or development, and alter roadway alignments, similar to effects of a setback levee; however, an adjacent levee would have a smaller footprint than a setback levee and, because structures are often set back from the levee, would require less displacement.

Physical demolition of residences and businesses would add to the already heightened negative perception of the proposed program because of the finality of the action that was initiated with displacement, in addition to creating a visual eyesore during such activities. This effect would be significant. While implementation of Mitigation Measure VIS-MM-1 would help mitigate some of the effect of construction equipment on residential viewers, construction activities and the removal of vegetation would be a significant and unavoidable effect on all viewer groups.

Effect VIS-2: Substantially Adversely Affect a Scenic Vista

The program area is filled with scenic vistas. Major roads through the program area act as gateways and offer unique vistas of the contrasting landscape features. Development and the high-rise buildings of West Sacramento and Sacramento that tower over agricultural fields are softened by the lush riparian corridors that line the waterways. A new setback levee adjacent to the existing levee could alter roadway alignments and introduce a large mass that would block views of the vegetated waterways, affecting vistas from all vantages. There is no available mitigation.

In instances where an adjacent levee is constructed using the existing levee, it is likely that agricultural fields, orchards, or development would be displaced, and that roadway alignments would be altered. However, removal of vegetation within 15 feet of the levee toe would also open up additional vistas from levee roadways and vantages adjacent to erosion sites. Changes at the erosion sites from vantages outside the program area would not be very noticeable, and would be similar to Alternative 2A due to the distance from the program area, length of erosion sites, and gaps that currently exist. However, because some setback levees would be constructed as part of this alternative and would affect vistas from all vantages, this effect would be significant and unavoidable. There is no available mitigation.

Effect VIS-3: Substantially Damage Scenic Resources, including, but Not Limited, to Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway

SR 160 is a state-designated scenic highway and is located within Regions 1a and 1b. A new adjacent levee or setback levee adjacent to the existing levee would alter the alignment of SR 160 and county-designated scenic routes and take away highly valued views of adjacent waterways. This effect would be significant and unavoidable. There is no available mitigation. A state-designated scenic highway in Regions 1a and 1b would be affected. This effect may also occur along county-designated scenic routes, which would be identified during project-level analysis, for all regions.

Effect VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings

In areas where a setback levee is constructed, Alternative 3A would introduce a new levee in the viewshed of all viewer groups. Major roads through the program area are aligned on levee tops, cross over affected waterways, or are in sufficiently close proximity to have views of the program area. Residential and commercial development also often has direct views of the program area. After a project is constructed, these viewers would see a levee where residences, businesses, agricultural fields, or vegetation once existed, resulting in a negative visual shift in character. Lush riparian corridors that line the waterways softened the appearance of development and the high-rise buildings of West Sacramento and Sacramento that tower over agricultural fields. For areas where an adjacent levee is constructed, removal of all vegetation within the levee footprint and 15 feet of the levee toe would constitute a drastic visual change at these locations. While vegetation beyond the 15-foot VFZ would be allowed to remain, the majority of waterways in the program area do not have such areas and the result would be complete vegetation removal at erosion sites. Even in sites where there is area to support vegetative and IWM environmental compensation, complete vegetation removal would still occur on the levee slope and within the levee footprint and 15 feet of the levee toe at erosion sites. This complete removal would contrast sharply from the existing visual landscape, alter the visual character from one that is vegetated with large trees and shrubs to one that is rocked and grassed, and degrade the overall visual quality. These changes in views would be perceived by all viewer groups. Therefore, the proposed program would have a long-term significant and unavoidable effect on the existing visual character and quality of the site and its surroundings. There is no available mitigation.

Effect VIS-5: Create a New Source of Light or Glare

A new setback levee adjacent to the existing levee, or an adjacent levee, would introduce a new visual feature in the environment and could displace agricultural fields, orchards, or development. A new setback levee would not introduce new sources of light, but it would introduce a large surface of grass and rock, increasing glare for all viewer groups. This effect would be significant and unavoidable. There is no available mitigation.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect VIS-1: Temporary Visual Effects Caused by Construction Activities

This effect would be the same as under Alternative 3A.

Effect VIS-2: Substantially Adversely Affect a Scenic Vista

This effect would be similar to the effect under Alternative 3A, but at a lesser magnitude because Bank Protection Measure 4 implements vegetative and IWM environmental compensation. Under Bank Protection Measure 4, constructed benches would be planted with riparian vegetation, and revegetation would occur in areas where setback levees and adjacent levees are constructed to partially restore scenic resources, as seen from a scenic vista. However, there would still be substantial damage to views seen from scenic vistas, and restored areas would take time for new vegetation to mature. Therefore, this effect would be significant and unavoidable. There is no available mitigation.

Effect VIS-3: Substantially Damage Scenic Resources, including, but Not Limited to, Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway

This effect would be similar to the effect under Alternative 3A, but at a lesser magnitude because Bank Protection Measure 4 implements vegetative and IWM environmental compensation. Under Bank Protection Measure 4, constructed benches would be planted with riparian vegetation, and revegetation would occur in areas where setback levees and adjacent levees are constructed to partially restore scenic resources. However, there would still be substantial damage to scenic resources, and restored areas would take time for new vegetation to mature. Therefore, this effect would be significant and unavoidable. A state-designated scenic highway in Regions 1a and 1b would be affected. This effect may also occur along county-designated scenic routes for all regions.

Effect VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings

Removal of all vegetation within the levee footprint and 15 feet of the levee toe at sites where bank protection measures 2 through 5 would be implemented constitutes a drastic visual change. While vegetation beyond the 15-foot VFZ would be allowed to remain, the majority of waterways in the program area do not have such areas and would result in complete vegetation removal at erosion sites. Even in sites where there is area to support vegetative and IWM environmental compensation, under bank protection measure 4, complete vegetation removal would still occur on the levee slope and within 15 feet of the levee toe at erosion sites. This complete removal would contrast sharply from the existing visual landscape, alter the visual character from one that is vegetated with large trees and shrubs to one that is rocked and grassed, and degrade the overall visual quality. In addition, new vegetation would take time to mature in restored areas. These changes in views would be perceived by all viewer groups. Therefore, the proposed program would have a long-term significant and unavoidable effect on the existing visual character and quality of the site and its surroundings. There is no available mitigation.

Effect VIS-5: Create a New Source of Light or Glare

This effect would be similar to the effect under Alternative 3A. Bank Protection Measure 4 would not introduce new sources of light and would help to reduce glare, over time, as newly planted vegetation matures to provide shade and cover. However, a new setback levee adjacent to the existing levee and adjacent levees would introduce new visual features in the environment and likely displace agricultural fields, orchards, or development. While this could reduce nighttime light to a small degree, it would introduce a large surface of grass and rock, increasing glare for all viewer groups. This effect would be significant and unavoidable. There is no available mitigation.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect VIS-1: Temporary Visual Effects Caused by Construction Activities

This effect would be the same as under Alternative 4A.

Effect VIS-2: Substantially Adversely Affect a Scenic Vista

This effect would be the same as under Alternative 4A. Although fewer setback levees would be constructed under this alternative, scenic vistas would still be permanently altered, and there is no available mitigation.

Effect VIS-3: Substantially Damage Scenic Resources, including, but Not Limited, to Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway

This effect would be similar to the effect under Alternative 4A. Bank Protection Measure 4 would implement vegetative and IWM environmental compensation in areas where setback levees and adjacent levees are constructed to partially restore scenic resources. Even though fewer setback levees would be constructed under this alternative, there would still be substantial damage to scenic resources, and new vegetation would take time to mature in restored areas. Therefore, this effect would be significant and unavoidable. A state-designated scenic highway in Regions 1a and 1b would be affected. This effect may also occur along county-designated scenic routes, which would be identified during project-level analysis, for all regions.

Effect VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings

This effect would be similar to the effect under Alternative 4A. While vegetation beyond the 15-foot VFZ would be allowed to remain, vegetation removal within the VFZ would be implemented under Bank Protection Measures 2 through 5. This would constitute a drastic visual change because the majority of waterways in the program area do not have vegetated areas beyond the VFZ. The result would be complete vegetation removal at erosion sites. Bank Protection Measure 4 would implement vegetative and IWM environmental compensation in areas where setback levees and adjacent levees are constructed to partially restore scenic resources. However, fewer setback levees would be constructed under this alternative, and new vegetation would take time to mature in restored areas. Therefore, this alternative would still result in substantial damage to the existing visual character, and these changes in views would be perceived by all viewer groups. The proposed program would have a long-term significant and unavoidable effect on the existing visual character and quality of the site and its surroundings. There is no available mitigation.

Effect VIS-5: Create a New Source of Light or Glare

This effect would be similar to the effect under Alternative 4A. Bank Protection Measure 4 would introduce no new sources of light and would help to reduce glare, over time, as newly planted vegetation matures to provide shade and cover. However, fewer setback levees would be constructed under this alternative. The new setback levee adjacent to the existing levee and adjacent levees would introduce new visual features in the environment and likely displace agricultural fields, orchards, or development. While this could reduce nighttime light to a small degree, it would introduce a large surface of grass and rock, increasing glare for all viewer groups. Therefore, this effect would be significant and unavoidable. There is no available mitigation.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect VIS-1: Temporary Visual Effects Caused by Construction Activities

This effect would be comparable in type to Alternative 4A, but at a lesser magnitude because there would be no bank fill stone protection with no on-site vegetation or adjacent levees constructed. Mitigation Measure VIS-MM-1 would lessen this affect, but it would still be considered significant and unavoidable, because there would still be intensive vegetation removal, earthwork, and construction related to the adjacent levees, riparian and wetland benches with revegetation, and bank fill stone protection with on-site vegetation. There is no available mitigation.

Effect VIS-2: Substantially Adversely Affect a Scenic Vista

This effect would be comparable in type as it would be under Alternative 4A, but at a lesser magnitude. Vegetation would not be removed within the VFZ, but would be allowed to remain on the levee, and adjacent levees would not be constructed. Therefore, this effect would be less than significant.

Effect VIS-3: Substantially Damage Scenic Resources, including, but Not Limited to, Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway

This effect would be similar to the effect under Alternative 4A, but at a lesser magnitude because vegetation would be allowed to remain on levees within the VFZ and many sites would have vegetation restored through Bank Protection Measure 4. However, there would still be substantial damage to scenic resources with the removal of vegetation. Construction of setback levees and riparian and wetland benches would affect scenic resources because they would require vegetation removal to construct and introduce a new or modified landform. New vegetation would take time to mature and appear more natural and closer to existing conditions in restored areas. Placement of bank fill stone protection where none previously existed would alter views of earthen or vegetated banks, even with selected on-site vegetation remaining. Therefore, this effect would be significant and unavoidable. A state-designated scenic highway in Regions 1a and 1b would be affected. This effect may also occur along county-designated scenic routes, which would be identified during project-level analysis, for all regions.

Effect VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings

Under Alternative 6A, a number of bank protection measures would involve protection of existing vegetation and placement of on-site mitigation vegetation within the VFZ. However, many of the erosion sites would still have vegetation removed as part of construction, which would degrade the existing visual character. Construction of setback levees and riparian and wetland benches would affect scenic resources because they would require vegetation removal to construct and introduce a new or modified landform. New vegetation would take time to mature and appear more natural and closer to existing conditions in restored areas. Placement of bank fill stone protection where none previously existed would alter views of earthen or vegetated banks, even with selected on-site vegetation remaining. This effect is considered significant and unavoidable. There is no available mitigation.

Effect VIS-5: Create a New Source of Light or Glare

Erosion sites where low riparian benches with revegetation are constructed would create a new source of light and glare in the same manner as under Alternative 4A, but would be of a lesser magnitude in areas where existing vegetation is protected. Bank Protection Measure 4 would help to reduce glare, over time, as newly planted vegetation matures to provide shade and cover. However, the new setback levee adjacent to the existing levee and adjacent levees would introduce new visual features in the environment and likely displace agricultural fields, orchards, or development. While this could reduce nighttime light to a small degree, it would introduce a large surface of grass and rock, increasing glare for all viewer groups. This effect would be significant and unavoidable. There is no available mitigation.

Chapter 18
Public Health and Environmental Hazards

Introduction and Summary

This chapter describes the environmental setting associated with public health and environmental hazards, the determination of effects, the environmental effects associated with public health and environmental hazards that would result from implementation of the proposed program, and the mitigation measures that would reduce these effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- Program area county general plans.
- American River Parkway Plan (Sacramento County 2008).
- Existing Sacramento River Bank Protection Project (SRBPP) documents:
    - Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites: Sacramento River Bank Protection Project (U.S. Army Corps of Engineers 2009).
    - Final Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009: Sacramento River Bank Protection Project, Sacramento River and Tributaries, California (U.S. Army Corps of Engineers 2008).
    - Environmental Assessment/Initial Study for Five Critical Erosion Sites, River Miles 26.9 Left, 34.5 Right, 72.2 Right, 99.3 Right, and 123.5 Left Sacramento River Bank Protection Project, Draft (U.S. Army Corps of Engineers 2006a).
    - Environmental Assessment for levee repair of 14 Winter 2006 critical sites, Sacramento River Bank Protection Project, Final Report (U.S. Army Corps of Engineers 2006b).
- California Department of Toxic Substances Control Envirostor database. (California Department of Toxic Substances Control 2007)

Table 18-1 summarizes the public health and environmental hazards effects resulting from the implementation of the proposed program.

Table 18-1. Summary of Public Health and Environmental Hazards Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction	None required	Not applicable
PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities	WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality; PH-MM-1: Employ a Toxic Release Contingency Plan	During construction
PH-3: Temporary Exposure to Safety Hazards from the Construction Site	PH-MM-2: Implement Construction Site Safety Measures; PH-MM-3: Implement an Emergency Response Plan	During construction

Effect	Mitigation Measures	Implementation Period
PH-4: Exposure of People or Structures to Increased Flood Risk	None required	Not applicable
PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife	Mitigation Measure PH-MM-4: Design and Manage Habitat Created by Setback Levees Such That It Does Not Attract Wildlife Known to Collide with Aircraft	During project-level design, construction, and O&M

Environmental Setting

Existing Conditions

Hazardous Materials

Hazardous materials are chemicals and other substances defined as hazardous by federal and state laws and regulations. In general, these materials are substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may have harmful effects on public health or the environment during their use or when released to the environment. Hazardous materials also include waste chemicals and spilled materials.

Potential Sources of Hazardous Materials

The program area levee reaches are located in urban, suburban, and rural areas. Potential sources of hazardous materials and waste may exist in the urbanized as well as agricultural areas adjacent to the levees. Hazardous materials may be present in the program area in a variety of common contexts, including:

- Pesticides, herbicides, and fertilizers associated with agricultural lands.
- Petroleum hydrocarbons.
- Underground storage tanks.
- Contaminated debris.
- Lead associated with paints and structures.
- Wastewater.
- Pits or ponds.
- Stormwater runoff structures.
- Transformers that may contain polychlorinated biphenyls (PCBs).

Known Sources of Hazardous Materials

The Department of Toxic Substances Control's (DTSC's) Envirostor database provides access to detailed information on hazardous waste permitted and corrective action facilities within California, as well as existing site cleanup information. According to the Envirostor Database, the following known sources of hazardous materials are located adjacent to or along program levees, and consist of federal superfund, state response, military evaluation, evaluation sites, voluntary cleanup, and permitted hazardous waste sites (California Department of Toxic Substances Control 2007). Evaluation sites are typically 1) in the preliminary phase of a site investigation, 2) were found to have no contamination, and/or 3) were referred to another agency or program. The sites located within the program area have been organized by program region in Table 18-2.

Table 18-2. Known Hazardous Materials Sources in Program Area

Region	Site Name	County	DTSC Category
1a	Rio Vista Storage	Solano	Military, inactive
1a	Rio Vista Army Reserve Center	Solano	State response, certified
1a	Yolo County Central Landfill	Yolo	Evaluation site
1a	Old Bryte Landfill	Yolo	Evaluation site
1b	Clark Trucking	Yolo	Evaluation site
1b	Ramos Environmental Service	Yolo	Evaluation site
1b	PG&E Manufactured Gas Plant	Sacramento	Evaluation site, inactive
1b	PG&E Sacramento Site	Sacramento	State response, active
1b	Sacramento Housing and Redevelopment Agency	Sacramento	State response, certified
1b	Caltrans, I-5 Q Street Off-ramp	Sacramento	State response, certified, land use restrictions
1b	SMUD, Front and T Streets	Sacramento	State response, certified, land use restrictions
1b	The Docks Area Sacramento EOA	Sacramento	Voluntary cleanup site, active
1b	Van Waters and Rogers, Inc.	Yolo	Evaluation site
1b	Westco Technologies	Yolo	Evaluation site
1b	Capitol Plating Corporation	Yolo	State response, active
1b	Jibboom Building	Sacramento	Voluntary cleanup site, certified
1b	Jibboom Junkyard	Sacramento	Federal Superfund site, certified
1b	Sacramento Signal Depot	Sacramento	Military evaluation
1b	Sac ENGR Area-Weir Area	Yolo	Military evaluation
2	Onstott Dusters Inc./Sutter Co Airport	Sutter	Evaluation site
2	PG&E Manufactured Gas Plant	Yuba	Evaluation site, inactive
2	PG&E Marysville	Yuba	Voluntary cleanup site, certified, land use restrictions
2	Triangle Engineering	Yuba	Evaluation site
2	Lomo Airstrip	Sutter	State response, de-listed
2	PG&E MGP, Colusa	Colusa	State response site, active
3	Delta Industries	Colusa	Evaluation site
3	Colusa-Sacramento River State Recreation	Colusa	Evaluation site
3	Davies Oil Company	Colusa	Evaluation site
3	Allen Property Burn Piles	Butte	Voluntary cleanup site, certified

Source: Department of Toxic Substances Control 2007.

Agricultural Lands

The program area has large tracts of agricultural lands throughout the counties in the program area. Agricultural lands are known to have various pesticides, herbicides, and fertilizers in their soils, and can pose a risk to local and regional water quality because these areas are largely considered floodplain for the Sacramento River. The river elevation fluctuates seasonally and the groundwater elevation is assumed to fluctuate with river levels. During periods of low flow, it is likely that groundwater flows from agricultural lands toward the river and that any contaminated water could be transported to the soils within and near the levees.

Wildland Fires

The large areas of undeveloped, agricultural, and forested land in the program area pose a serious risk for wildland fires. These areas are largely agricultural lands that have been left fallow or lands that are composed primarily of annual grasses that become dry during summer months, which raises the risk of grassland fire. Areas of this type are found throughout the program area; however, wildland fire risk is increased in rural locations.

Various city and county agencies are responsible for controlling and responding to wildland fires. For areas that are incorporated into cities and towns within the program area, city fire departments are responsible for responding to fires. Many unincorporated areas have formed fire districts that are primarily protected by county fire departments. Other entities involved in wildland fire protection are the California Department of Forestry and Fire Protection and the U.S. Forest Service. Some areas within the program area also have volunteer fire departments for fighting wildland fires. Refer to Chapter 16, Utilities and Public Services, for a detailed discussion.

Emergency Response

Emergency response and evacuation services for the program area are provided by various departments in the counties and cities nearest to the program area, including, but not limited to, sheriff, fire, and emergency services departments.

Airport Safety

The Sacramento International Airport (SIA) and the Chico Municipal Airport serve the Sacramento Valley region, and are the airports that provide commercial flights in the program area. Other airports that serve the program are municipal, providing local flights and serving personal aircraft.

The SIA has one of the highest numbers of reported wildlife strikes with aircraft of all California airports (Sacramento County Airport System 2009). Collisions between aircraft and wildlife compromise the safety of aircraft passengers and flight crews. In an attempt to reduce wildlife collisions with aircraft, the Sacramento County Airport System has maintained and implemented the Wildlife Hazard Management Plan (WHMP) for more than 10 years at the SIA. The plan identifies routine maintenance, hazardous wildlife habitat manipulation, and other land management activities as the most effective long-term preemptive measures for reducing wildlife hazards.

As described in the Federal Aviation Administration's (FAA's) AC 150/5200-33B, *Hazardous Wildlife Attractants on or Near Airports*, the FAA recommends a separation distance of 10,000 feet between the airport operations area and hazardous wildlife attractants (Federal Aviation Administration 2007); this area is identified as the Airport Critical Zone. Additionally, the FAA recommends a distance of 5 statute miles[1] between the farthest edge of the airport operations area and hazardous

[1] A statute mile is a unit of length used in the United States, the United Kingdom, and certain other countries that is equal to 5,280 feet or 1.61 kilometers. The statute mile is commonly referred to as a *mile* or *land mile* and is used to distinguish a mile of 5,280 feet from the nautical mile of approximately 6,076 feet.

wildlife attractants (Federal Aviation Administration 2007). Open water and agricultural crops are recognized as being the greatest wildlife attractants in the SIA vicinity, and rice cultivation is considered the most incompatible agricultural crop because it necessitates flooding. Wildlife attractants near the runways are of greatest concern because, nationally, 74% of bird-aircraft strikes occurred at or below 500 feet above ground level (Cleary et al. 2004). The area within a 10,000-foot radius of the airport operations area is where arriving and departing aircraft are typically operating at or below 2,000 feet, an altitude that also corresponds with most bird activity (Sacramento County Airport System 2009).

Regulatory Setting

Appendix C, Regulatory Background, describes the federal, state, and local laws, regulations, and policies that pertain to public health and environmental hazards within the program area.

Determination of Effects

This section describes the effects analysis for the program relating to environmental hazards and public health. It describes the methods used to determine the effects of the program and lists the thresholds used to conclude whether an effect would be significant. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant effects accompany each effect discussion.

Assessment Methods

The evaluation of potential effects on public health and environmental hazards addresses the potential for health and safety hazards during construction of the levee improvements. The analysis includes evaluation of (1) the potential effects related to construction activities on workers, and (2) general safety of and hazards to both workers and the public posed by construction, operations and maintenance associated with implementation of the proposed program.

Significance Criteria

Criteria used for determining the significance of an effect on public health and environmental hazards are based on the environmental checklist included in Appendix G (14 CCR 15000 *et seq*.) of the State CEQA Guidelines as well as professional standards and practices. The proposed program was considered to cause a significant effect if it would result in any of the following conditions.

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials.
- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials to the environment.
- Emit hazardous emissions or involve handling hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school.

- Be located on a site that is on a list of hazardous materials sites compiled pursuant to California Government Code 65962.5, and as a result would create a significant hazard to the public or the environment.
- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.
- Place within a 100-year flood hazard area structures that would impede or redirect floodflows.
- Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.
- Adversely affect drinking water quality.
- Result in a safety hazard for people residing or working in a project area that is located within 2 miles of a public airport or public-use airport.

The proposed program would not involve hazardous emissions or the handling of hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. In addition, the proposed program would not place structures within the 100-year flood hazard area. Therefore, the third and sixth criteria do not apply and are not addressed further in this analysis.

For this analysis, airport safety was analyzed within the Airport Critical Zone and the airport operations area for the SIA. The FAA recommends a separation distance of 10,000 feet between the airport operations area and hazardous wildlife attractants (Federal Aviation Administration 2007); this area is identified as the Airport Critical Zone. Additionally, the FAA recommends a distance of 5 statute miles between the farthest edge of the airport operations area and hazardous wildlife attractants (Federal Aviation Administration 2007).

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, no construction activities associated with the program would occur. Thus the proposed program would not result in accidental spills of hazardous materials, nor would there be any affect to emergency response, as there would be no interference with emergency response routes. Any public health or hazards effects related to ongoing O&M activities would not be different from current (baseline) conditions.

However, without erosion improvements to the program area, the risk of levee failure would remain high. A levee failure within the SRBPP area could result in flooding that would upset stored hazardous materials and spread agricultural pesticides, oil, gasoline, and other hazardous materials in flood waters, creating hazardous conditions for the public and the environment. However, the timing, duration, magnitude, and location for such an occurrence cannot be predicted.

Alternative 2A—Low Maintenance

Effect PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction

Construction associated with Alternative 2A would involve the use of hazardous materials, such as fuels and lubricants, associated with the operation of construction equipment and vehicles (i.e., excavators, compactors, haul trucks, and loaders). Fuels and lubricants have the potential to be released into the environment at construction sites and along haul routes, causing potential environmental and/or human exposure to these hazards. The implementation of a stormwater pollution prevention plan (SWPPP), which would be required by the State Water Quality Control Board for any construction activities that disturb 1 acre or more, would ensure that this effect would be less than significant by requiring the implementation of best management practices (BMPs) to prevent and/or minimize exposure to or release of hazardous materials. Some BMPs that could be implemented by the Corps and its contractors include, but are not limited to, the following:

- Restrict the volume of petroleum products allowed onsite to the volume that can be addressed by the spill control and response measures included in the SPCCP;
- Store hazardous materials in staging areas at least 100 feet from streams and other water bodies and store the materials so that they cannot come into contact with stormwater, including providing a cover from the rain and elevating the material from the ground on pallets;
- Perform refueling and vehicle maintenance at least 100 feet from streams and other water bodies;
- Minimize equipment operations in flowing water;
- Inspect equipment to ensure that seals prevent any fuel, engine oil, or other fluids from leaking, and
- Dispose of soils contaminated with fuels or chemicals at an approved facility appropriate to the type and degree of contamination to prevent discharge to surface waters and in accordance with the rules and regulations of the U.S. Department of Transportation, the EPA, and the California Environmental Protection Agency (CalEPA).

The SWPPP would also require regular inspections of BMPs to ensure that they are being maintained, to confirm that they are performing adequately, and to determine if additional or different BMPs should be implemented. Refer to Chapter 5, Water Quality and Groundwater Resources, for further description of SWPPP measures.

Because the above measures would prevent or reduce the likelihood of significant soil and ground water contamination from occurring and would minimize the extent and severity of contamination that could occur, this effect would be less than significant, No mitigation is required.

Effect PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities

Clearing and grading would likely be required in order to access the erosion site and install revetment along the levee slope and stream bank. This ground disturbance may expose humans or the environment to contaminants that would otherwise remain buried in or near the levee. Implementation of a SWPPP and an SPCCP would ensure that the risk of accidental exposures and releases into the environment would be minimal and that the effect would be less than significant.

However, if a release were to occur, Mitigation Measures WQ-MM-2 and PH-MM-1 would be implemented to ensure that water quality is returned to baseline conditions and that any threat to public health is responded to effectively.

Mitigation Measure WQ-MM-2: Implement Measures to Maintain Surface Water Quality and Groundwater Quality.

Refer to Chapter 5, Water Quality and Groundwater Resources, for a detailed description of this mitigation measure.

Mitigation Measure PH-MM-1: Employ a Toxic Release Contingency Plan

The construction contractor will coordinate with regional and local planning agencies to incorporate a toxic release contingency plan, pursuant to California Government Code Section 8574.16, which requires that regional and local planning agencies incorporate such a measure within their planning. Implementation of this plan will ensure the effective and efficient use of resources in the areas of traffic and crowd control; firefighting; hazardous materials response and cleanup; radio and communications control; and provision of medical emergency services. Implementation of this mitigation measure will ensure that this effect would be less than significant.

Effect PH-3: Temporary Exposure to Safety Hazards from the Construction Site

Construction associated with Alternative 2A would involve operation of vehicles and other mechanical equipment by construction workers that, if used improperly, could result in safety hazards at the construction site to workers and the public (i.e., pedestrians, bicyclists). Also, the staging of the equipment outside the hours of operation (i.e., weekends, holidays, and overnight) may pose a threat to public safety if the equipment is not properly secured. Implementation of Mitigation Measures PH-MM-2 and PH-MM-3 would ensure this effect would be less than significant.

Mitigation Measure PH-MM-2: Implement Construction Site Safety Measures

The construction contractor will ensure that all workers are properly trained to operate equipment. Safety precautions will be followed at all times during construction to avoid accidents. The construction contractor will also require that all workers have valid drivers' licenses and insurance. Proper signage and detours will be provided to ensure public safety.

Mitigation Measure PH-MM-3: Implement an Emergency Response Plan

Development of an emergency response plan will ensure that any accidents that occur at the construction site will be responded to appropriately. The construction contractor will develop the emergency response plan, taking into consideration the location of nearby emergency response agencies as well as emergency response access routes and response times.

Effect PH-4: Exposure of People or Structure to Increased Flood Risk

All levees have the potential to fail, regardless of design. The Corps has set forth guidelines for levee design (EM-1110-2-1913). Alternative 2A would result in improved levees in the program area through implementation of bank protection and erosion prevention methods that meet engineering requirements set forth by both the Corps and the Central Valley Flood Protection Board. This would be an improvement compared with the existing flood protection. Therefore, this effect would be beneficial. No mitigation is necessary.

Effect PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife

Generally, the Airport Critical Zone surrounding SIA is used for agricultural purposes, a land use practice that is considered to attract hazardous wildlife. Implementation of Alternative 2A would not increase the amount of hazardous wildlife habitat because the only on-site vegetation to be included in Alternative 2A implementation is mown grass. Because Alternative 2A does not increase the amount of hazardous wildlife habitat, there would be no effect.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction

These effects would be similar in type to those described above for Alternative 2A, but at a greater magnitude due to the extensive amount of earthmoving and construction vehicles required to construct a setback levee or adjacent levee, which would increase the chance of a hazardous material spill. However, the implementation of a SWPPP would ensure that this effect would be less than significant. No mitigation is required.

Effect PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities

These effects would be similar in type to those described above for Alternative 2A, but at a greater magnitude due to the extensive amount of earthmoving required to construct a setback levee or adjacent levee, which would increase the chance of an exposure to, or release of, underground contamination sources. However, implementation of a SWPPP would ensure that the risk of accidental exposures and releases into the environment would be minimal and that the effect would be less than significant. If a release were to occur, Mitigation Measures WQ-MM-2 and PH-MM-1 would be implemented to ensure that water quality is returned to baseline conditions and that any threat to public health is responded to effectively.

Effect PH-3: Temporary Exposure to Safety Hazards from the Construction Site

This effect would be similar in type to that described above for Alternative 2A. Implementation of Mitigation Measures PH-MM-2 and PH-MM-3 would ensure this effect would be less than significant.

Effect PH-4: Exposure of People or Structure to Increased Flood Risk

This effect would be similar in type to that described above for Alternative 2A.

Effect PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife

Alternative 3A would create the potential for an increase in wildlife habitat because the construction of setback levees would increase areas that could be replanted as mitigation for vegetation removal at other erosion sites. Construction of adjacent levees, however, is not expected to result in a net increase in wildlife habitat because under this measure, vegetation would be removed from the landward side of the existing levee.

An analysis using geographic information systems and Google Earth was conducted to determine the proximity of public airports to potential sites where the setback levees would be constructed. Of the 106 selected erosion sites along the Sacramento River and its tributaries, which constitute a representative sample of the sites eventually to be treated under the supplemental 80,000 linear feet (LF), three potential setback levee sites are proposed within 5 miles (i.e., 26,400 feet) of a public airport. Specifically, all three potential setback levee sites are within the 5-mile buffer of the Colusa County Airport (located 3 miles south of Colusa). New vegetation planted in the setback areas and inundation of the setback areas would have the potential to provide wildlife habitat that could increase the risk of wildlife strikes at Colusa County Airport.

As discussed in Chapter 2, Project Description, the number and extent of documented sites can change from year to year because of various factors, including identification of new sites, increased or decreased rates of erosion, repair of sites, reclassification of erosion sites to maintenance sites, and removal of sites. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed within the 5-mile buffer of any public airport. Because Alternative 3A involves the construction of setback levees within the 5-mile buffer that could potentially increase habitat that would attract wildlife known to collide with aircraft (e.g., waterfowl [Federal Aviation Administration 2014]), this effect is potentially significant. Implementation of Mitigation Measure PH-MM-4 would reduce this effect to a less-than-significant level.

Mitigation Measure PH-MM-4: Design and Manage Habitat Created by Setback Levees Such That It Does Not Attract Wildlife Known to Collide with Aircraft

At potential setback levee sites that are within the 5-mile buffer of public airports, the Corps will ensure that new habitat areas created by the setback levees will be designed and managed in such a way that it will not attract wildlife known to collide with aircraft (i.e., primarily waterfowl [FAA 2014]). Implementing routine maintenance, hazardous wildlife habitat manipulation, and other land management activities have been identified as the most effective long-term preemptive measures for reducing wildlife hazards (Sacramento International Airport 2013).

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction

These effects would be similar in type to those described above for Alternative 3A, but at a lesser magnitude because fewer setback levees or adjacent levees would be constructed, which would decrease the chance of a hazardous material spill compared with Alternative 3A. Implementation of a SWPPP would ensure that this effect would be less than significant. No mitigation is required.

Effect PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities

These effects would be similar in type to those described above for Alternative 3A, but at a lesser magnitude because fewer setback levees or adjacent levees would be constructed, which would decrease the chance of an exposure to, or release of, underground contamination sources when compared to Alternative 3A. Implementation of a SWPPP would ensure that this effect would be considered less than significant. If a release were to occur, Mitigation Measures WQ-MM-2 and PH-

MM-1 would be implemented to ensure that water quality is returned to baseline conditions and that any threat to public health is responded to effectively.

Effect PH-3: Temporary Exposure to Safety Hazards from the Construction Site

This effect would be similar in type to that described above for Alternative 2A. Implementation of Mitigation Measures PH-MM-2 and PH-MM-3 would ensure this effect would be less than significant.

Effect PH-4: Exposure of People or Structure to Increased Flood Risk

This effect would be similar in type to that described above for Alternative 2A.

Effect PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife

This effect would be similar in type to that described above for Alternative 3A; however, no setback levees are proposed within the recommended 5-mile buffer around public airports under Alternative 4A. In addition, there would be no net increase in wildlife habitat at sites within the buffer that would implement other bank protection measures. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed within the 5-mile buffer of any public airport. However, because Alternative 4A would result in no net increase in the amount of habitat considered to attract hazardous wildlife within the 5-mile buffer, this effect is considered less than significant. No mitigation is necessary.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction

These effects would be similar in type to those described above for Alternative 3A, but at a lesser magnitude because fewer setback levees or adjacent levees would be constructed, which would decrease the chance of a hazardous material spill compared to Alternative 3A. Implementation of a SWPPP would ensure that this effect would be less than significant. No mitigation is required.

Effect PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities

These effects would be similar in type to those described above for Alternative 3A, but at a lesser magnitude because fewer setback levees or adjacent levees would be constructed, which would decrease the chance of an exposure to, or release of, underground contamination sources when compared to Alternative 3A. Implementation of a SWPPP would ensure that this effect would be considered less than significant. If a release were to occur, Mitigation Measures WQ-MM-2 and PH-MM-1 below would be implemented to ensure that water quality is returned to baseline conditions and that any threat to public health is responded to effectively.

Effect PH-3: Temporary Exposure to Safety Hazards from the Construction Site

This effect would be similar in type to that described above for Alternative 2A. Implementation of Mitigation Measures PH-MM-2 and PH-MM-3 would ensure this effect would be less than significant.

Effect PH-4: Exposure of People or Structure to Increased Flood Risk

This effect would be similar in type to that described above for Alternative 2A.

Effect PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife

This effect would be similar in type to that described above for Alternative 3A. Additionally, setback levees are proposed within the recommended 5-mile buffer around public airports under Alternative 5A would create the potential for an increase in wildlife habitat because the construction of setback levees would increase areas that could be replanted as mitigation for vegetation removal at other erosion sites. However, there would be no net increase in wildlife habitat at sites within the buffer that would implement other bank protection measures. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed within the 5-mile buffer of any public airport. However, because Alternative 5A involves the construction of setback levees that could potentially increase habitat that would attract wildlife known to collide with aircraft, this effect is potentially significant. Implementation of Mitigation Measure PH-MM-4 would reduce this effect to a less-than-significant level.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction

This effect would be similar in type to that described above for Alternative 3A, but at a lesser magnitude because fewer setback levees would be constructed, which would decrease the chance of a hazardous material spill compared to Alternative 3A. Implementation of a SWPPP would ensure that this effect would be less than significant. No mitigation is required.

Effect PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities

This effect would be similar in type to that described above for Alternative 3A, but at a lesser magnitude because fewer setback levees would be constructed, which would decrease the chance of an exposure to, or release of, underground contamination sources when compared to Alternative 3A. Implementation of a SWPPP would ensure that this effect would be considered less than significant. If a release were to occur, Mitigation Measures WQ-MM-2 and PH-MM-1 below would be implemented to ensure that water quality is returned to baseline conditions and that any threat to public health is responded to effectively.

Effect PH-3: Temporary Exposure to Safety Hazards from the Construction Site

This effect would be similar in type to that described above for Alternative 2A. Implementation of Mitigation Measures PH-MM-2 and PH-MM-3 would ensure this effect would be less than significant.

Effect PH-4: Exposure of People or Structure to Increased Flood Risk

This effect would be similar in type to that described above for Alternative 2A.

Effect PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife

This effect would be similar in type to that described above for Alternative 3A; however, no setback levees are proposed within the recommended 5-mile buffer around public airports under Alternative 6A. In addition, there would be no net increase in wildlife habitat at sites within the buffer that would implement other bank protection measures. As discussed in Chapter 2, Project Description, the environmental analysis in this EIS/EIR is programmatic in nature, analyzing the 80,000 LF in its entirety. Additional project-level environmental documentation, tiering from this programmatic analysis, will be conducted to address erosion sites that will be constructed within the 5-mile buffer of any public airport. However, because Alternative 6A would result in no net increase in the amount of habitat considered to attract hazardous wildlife within the 5-mile buffer, this effect is considered less than significant. No mitigation is necessary.

Chapter 19
Cultural Resources

Introduction and Summary

This chapter describes the environmental setting associated with cultural resources, assesses the impacts on cultural resources that would result from implementation of the proposed program, and presents mitigation measures that would reduce these impacts. The key sources of data and information used in the preparation of this chapter are listed below.

- A records search and review of existing information.
- Consultation with interested parties.
- Archival research.
- Limited field surveys of the program area.

Because the proposed program is subject to several laws governing the consideration of cultural resources, including NEPA, Section 106 of the National Historic Preservation Act (NHPA), 16 U.S.C. § 470f, and CEQA, and because the proposed program would be implemented over a number of years in several phases, the program lends itself to a phased approach to historic properties management as permitted under 36 Code of Federal Regulations (CFR) Section 800.14(b). Consequently, it was determined that developing a cultural resources Programmatic Agreement (PA) for the proposed program and an attending historic properties treatment plan (HPTP) is the most effective way to comply with the NHPA, and CEQA. The PA was agreed upon and signed by the Corps, the California State Historic Preservation Officer (SHPO), and the Central Valley Flood Protection Board (CVFPB). Concurring parties include the Shingle Springs Rancheria, the Mechoopda Tribe, and the Central Valley Miwok. The HPTP was prepared and attached to the PA (Appendix B, Cultural Resources Programmatic Agreement). The purpose of the HPTP is to direct cultural resource management activities during the life of the proposed program. Documentation of consultation for the PA can be found in Appendix H.

Pursuant to the Cultural Resources PA/HPTP, as the specific construction schedule is determined and the boundaries of the erosion site project areas are identified, including access routes and staging areas, the Corps will conduct archaeological survey(s) to identify if cultural resources are present (or absent). The Corps will document previously recorded or newly discovered cultural resources sites, and make a determination as to their potential eligibility for nomination to the National Register of Historic Places. The Corps will then determine if the resources can be avoided, if the project would adversely affect eligible historic properties, and, if so, how to mitigate for those effects. If human remains are discovered or if mitigation is necessary, the Corps will consult with the signatories and concurring parties to the PA (Attachment 1 of Appendix B).

Table 19-1 summarizes the cultural resources effects resulting from the implementation of the proposed program.

Table 19-1. Summary of Cultural Resources Effects and Mitigation

Effect	Mitigation Measures	Implementation Period
Effect CUL-1: Disturbance of Native American or Historic Period Human Remains	CUL-MM-1: Stop Work if Human Remains Are Discovered	During construction
Effect CUL-2: Unavoidable Impacts to Historic Properties or Historical Resources as a Result of Bank Protection Measures	CUL-MM-2: Identify Historic Properties and Historical Resources and Implement Treatment Measures for Adverse Effects according to the Historic Properties Treatment Plan	Before and during construction
Effect CUL-3: Loss of Integrity of Character-Defining Elements that Would Qualify the Sacramento River Levee System as a Historic Property (NHPA) or Historical Resource (CEQA)	CUL-MM-3: Evaluate the Sacramento River Levee System for NRHP Eligibility and Implement Treatment Measures for Adverse Effects According to the Historic Properties Treatment Plan	Before and during construction

Environmental Setting

The cultural setting of the Northern Sacramento Valley comprises a vast area with numerous Native American groups and historical time periods. These are summarized below, and a detailed description is provided in Appendix G, Cultural Context.

Native Americans

Seven Native American groups live within the program area: the Bay Miwok, Konkow Maidu, Northern Valley Yokuts, Patwin, Plains Miwok, River Nomlaki, and Valley Nisenan. Although various peoples dwelled in the area now known as the Central Valley and spoke a variety of languages, common linguistic roots indicate that these groups had a related history and regular interaction (Rosenthal et al. 2007:149). A shared heritage is also indicated by common technological, economic, ceremonial, and sociopolitical characteristics described by twentieth-century anthropologists who identified the Central Valley as the core of the California Culture area (Goldschmidt 1951; Klimek 1935; Kroeber 1936, 1939).

Early inhabitants of the Central Valley used the various habitats found throughout the valley, including riparian forest, marsh, alkali basins, oak savanna, and foothill woodland communities. They created a sophisticated material culture and established a trade system involving a wide range of manufactured goods from distant and neighboring regions, and their population and villages prospered in the centuries prior to historic contact (Rosenthal et al. 2007:147, 149).

Over time, however, the majority of surface sites in the Central Valley, including many mounds, were destroyed by agricultural development, levee construction, and river erosion. Also, many excavations of Central Valley sites in the early twentieth century were performed by untrained individuals who focused on artifact and burial recovery but paid little attention to other artifacts such as dietary remains and technological features, thus hampering modern attempts at reanalysis (Bouey 1995; Hartzell 1992). Additionally, the Central Valley's archaeological record has been affected by the natural processes of landscape evolution: Surface sites are embedded in young sediments set within a massive and dynamic alluvial basin, while most older archaeological deposits have been obliterated or buried by ongoing alluvial processes. Consequently, archaeologists are challenged to identify and explain long-term culture change in portions of the Central Valley where the majority of the available evidence spans only the past 2,500 years (or, in rare cases, the past 5,500 years) (Rosenthal et al. 2007:150).

There is no single cultural-historical framework that accommodates the entire prehistoric record of the Central Valley. Moratto's (1984) well-regarded synthesis of Central Valley archaeology was based on works from Bennyhoff and Fredrickson (Elsasser 1978: 37–57; Fredrickson 1973, 1974). The comparative frameworks established by Bennyhoff and Fredrickson (1994: 15–24) incorporated a wide range of local and regional traditions, but these have not been systematically applied outside of the Sacramento Valley.

History

Early American Settlements

The pace of physical change to the landscape and the construction of adobes and other structures widened as Spanish missions were disbanded in the 1830s and Mexican settlers took title to the land. Agriculture, grazing, and mining activities led to the establishment of permanent settlements and urban centers. The natural environment began to change rapidly as cattle and other domesticated animals grazed the land, as woodlands were cut for fuel and lumber, and as native vegetation gave way to imported grasses and plants spread by the settlers and their livestock.

Gold Rush

In January 1848, gold was discovered by James Marshall on the South Fork of the American River near present-day Coloma. Subsequent gold discoveries were made not long after that, such as the discovery by Jonas Spect on the Yuba River in the vicinity of Marysville in June 1848. The onset of the Gold Rush brought large numbers of people into California; miners poured into the area in search of placer deposits along the rivers and creeks of the Sacramento Valley and the adjacent Sierra Nevada foothills. When the placer deposits were depleted, the miners turned to other methods to reach gold-bearing strata. One of the most common methods of mining, hydraulic mining, introduced huge quantities of rock, sand, and mud into and adjacent to the mountain waterways. Later, mining companies deployed dredges to reach gold deposits along the rivers. Some of the tailings associated with this type of gold mining—particularly in and around the cities of Folsom and Oroville—have contributed to these cities' historic significance. The Gold Rush dramatically altered the landscape of California, particularly the Sacramento Valley and the counties and regions that are part of and surround the valley (Hoover et. al. 1990: 27, 290, 540).

Agriculture and Flood Control

The decline of the Gold Rush resulted in disenchanted miners who realized they could make a greater fortune through farming and ranching rather than prospecting, and they helped transform much of the Sacramento Valley into a booming agricultural region. Frequent floods plagued the residents of the region, however, and posed a significant threat to the viability of agricultural interests and further settlement. Advances in agricultural techniques, equipment, and water management from the 1880s to the early twentieth century brought the Sacramento Valley into the "fruit epoch." Agriculture replaced mining and cattle ranching as the valley's most profitable industry. By 1894, 75% of fruit shipped from California to the east coast was from the Sacramento Valley (Sacramento History Online 2004.)

Regulatory Setting

Appendix C, Regulatory Background, describes the federal and state laws, regulations, and policies that pertain to cultural resources within the proposed program area. Pertinent laws, regulations, policies, and plans are listed below.

- Federal:
  - National Environmental Policy Act
  - National Historic Preservation Act
  - Programmatic Agreement and Historic Property Treatment Plan
  - American Indian Religious Freedom Act
  - Archaeological Resources Protection Act
  - Native American Graves Protection and Repatriation Act
- State:
  - California Environmental Quality Act
  - Public Resources Code (PRC) Section 5097
  - California Health and Safety Code Section 8100
  - California Penal Code Sections 7050.5 and 7052.

Determination of Effects

Assessment Methods

Review of Existing Information

Terrestrial

The identification of cultural resources in the program area began with a records search conducted in 2009 at the Northeast Information Center, the North Central Information Center, and the Central California Information Center of the California Historical Resources Information System (CHRIS). The records search focused on identifying known and recorded resources and digitally plotting their locations on U.S. Geological Survey 7.5-minute topographic quadrangle maps. Although large portions of the program area have not been subject to archaeological survey, approximately 650 resources have been previously identified and documented within the program area.

Underwater

The California State Lands shipwreck database was consulted in August 2009. Literature from the ICF library was also consulted for potential submerged resources within the program area. A total of 16 previously discovered submerged resources were found to be located within the program area. Information from this research is documented in the Panamerican Consultants 2010 report.

Consultation with Interested Parties

Native American Groups

Native American groups with potential interest in the area were identified through the efforts of ethnographer Dr. Helen McCarthy. An initial list of potentially concerned tribes for the program area was obtained from the Native American Heritage Commission (NAHC). The initial list received from the NAHC was edited based on her recommendations and is included in the HPTP (Attachment 1 of Appendix B). The final list included 27 Native American groups and individuals. A series of scoping letters, phone calls, emails, and two workshops open to Native American groups were held in the spring of 2010 (one in Sacramento and one in Chico) to further identify interested parties. Based on this work and Dr. McCarthy's extensive experience in consulting with northern California tribes, in accordance with 36 CFR Part 800, the Corps has initiated consultation with the following tribes:

- Berry Creek Rancheria of Tyme Maidu Indians
- Buena Vista Rancheria of Me-Wuk Indians
- Cachil DeHe Band of Wintun Indians of the Colusa Indian Community
- California Valley Miwok Tribe
- Cortina Band of Indians, Enterprise Rancheria (Estom Yumeka)
- Enterprise Rancheria (Estom Yumeka)
- Grindstone Rancheria
- Ione Band of Miwok Indians
- Mechoopda Indian Tribe of Chico Rancheria
- Mooretown Rancheria of Maidu Indians
- Paskenta Band of Nomlaki Indians, Redding Rancheria
- Shingle Springs Band of Miwok Indians
- United Auburn Indian Community of Auburn Rancheria
- Wilton Rancheria
- Yocha Dehe Wintun Nation (Rumsey Rancheria)

Further consultation with the tribes involved requesting comments on the PA and HPTP, additional outreach meetings with individual tribes, and finally requesting their participation as concurring parties to the PA. All documentation regarding consultation with Native Americans is located in Appendix C and G of the HPTP (Attachment 1 of Appendix B, Cultural Resources Programmatic Agreement). To date, the California Valley Miwok Tribe, Mechoopda Indian Tribe of Chico Rancheria, and the Shingle Springs Band of Miwok have signed as concurring parties. Those tribes that have not signed the documented will still be given an opportunity to comment on specific construction projects as they are designed and planned.

Historical Groups

A total of 120 historical societies, museums, state parks, agencies, parks, and other institutions were solicited in 2009 for any knowledge they may have concerning local cultural resources. A full list of the consulted parties is provided in Chapter 2 of the HPTP (Attachment 1 of Appendix B). Responses were received from the Aerospace Museum of California, the Community Memorial Museum of Sutter County, the Department of Parks and Recreation (DPR) North Buttes District in Chico, West Sacramento Historical Society, and the California State Archives.

- Roxanne Yonn, executive director of Aerospace Museum of California, stated that the museum did not anticipate that the effort would affect the historic resources under its control.
- Julie Stark, director of the Community Memorial Museum of Sutter County, stated that the museum's only concern was the Hunter Burial Site. This site is located outside the program area and would not be impacted by the proposed program.
- Leslie Steidl, an archaeologist with the DPR North Buttes District in Chico, stated that she had several site records and other associated documents that could prove useful to the program. These were provided to the Corps. Ms. Steidl confirmed that all of the known sites have been recorded. Additionally, a detailed geomorphological description for the area is available.
- Thom Lewis, of the West Sacramento Historical Society, called and said that he possessed data regarding historical sites in the downtown Sacramento area and wanted to know the proposed program timeframe to insure he would send the Corps the information in time. Mr. Lewis agreed to follow up the phone call with an email attaching pictures of the historical sites. Mr. Lewis provided historic pictures of features on the west side of the Sacramento River and suggested contacting the Western Railway Museum in Suisun City. Currently there is no work planned for those areas. However, the Corps shall take into consideration the features should any program activity take place in those areas. A letter was sent to the Western Railway Museum to inquire about additional information.
- Linda Johnson, an archivist and the reference coordinator for the California State Archives, stated that because of staff limitations, the State Archives could not conduct in-depth research for the program area, but encouraged utilization the State Archives website and facilities to conduct research.

No other response has been received to date. However, should work affect a resource that would be of interest to historical groups, every effort will be made to involve them on the process.

Field Surveys

Terrestrial

From December 2009 to May 2010, ICF archaeologists conducted an intensive cultural resources survey of 16 repair areas within the program area. The 16 locations were chosen based on repair priority and access. A total of 53.25 acres were surveyed. Archaeologists walked transects no wider than 5 meters across all accessible areas within the area of potential effects (APE) for each repair location. This spacing ensured maximum ground coverage in a timely manner. The survey also included observation and inspection of cuts, fill, walls of drainage ditches and levees, and rodent burrow spoil piles. In areas with poor visibility, boot scrapes were conducted every 10 meters to more closely inspect the ground surface. No cultural resources were identified as a result of the survey effort. Methods, results, and locations of the surveys can be found in Chapter 2 of the HPTP (Attachment 1 of Appendix B).

Underwater

Panamerican Consultants, of Memphis, Tennessee, was hired to conduct a remote sensing survey within selected portions of the program area to identify submerged cultural resources (Panamerican Consultants 2010). Submerged resource types in the program area include the remains of landings, pilings, and modern and historic ships. Areas selected for survey were chosen based on three criteria: potential for locating cultural resources, number of identified levee repair locations in the area, and the goal of gathering data from a variety of location types. Areas with high potential for locating cultural resources were selected as a result of historic shipwreck data obtained during pre-field research. This documentation included information from the CHRIS, the California State Lands Commission Shipwreck Database, General Land Office maps, and newspaper articles. Eleven areas totaling approximately 50 miles in length were chosen for survey: Knights Landing, the mouth of the American River, northern Sacramento, the Old Sacramento waterfront, southern Sacramento, Hood/Courtland, Walnut Grove/Locke, Isleton, Steamboat Slough/Grand Island, Rio Vista, and Cache Slough. This study was conducted between September 22 and October 29, 2009. A total of 428 resources were identified as a result of the study. Of these, 73 resources were recommended for further study. Five potential NRHP-eligible resources were selected for dive investigation. Panamerican conducted 5 days of dive investigations to assess the five potential NRHP-eligible resources. Of these, three were recommended as eligible for listing on the NRHP. Detailed methods and results can be found in the HPTP (Attachment 1 of Appendix B).

Findings

Known Resources

Terrestrial

A total of 642 known cultural resources were identified within the program area as a result of the records search. Of these, 418 are historic structures and 224 are archaeological sites. Of the 224 archaeological sites, 127 are prehistoric archaeological sites, 67 are historical archaeological sites, and 30 sites contain both historic and prehistoric components.

Archaeological Resources

As part of on-going efforts to clarify and understand cultural resources risk prior to conducting full-coverage surveys, the Corps is currently engaged in the creation of a formal model of archaeological site sensitivity for a different project in the Central Valley (the American River Common Features Project [ARCF]). The ARCF project area falls within the larger program area. Part of this effort has involved quantifying the specific likelihood that archaeological sites will occur at increasing distances from sources of permanent water.

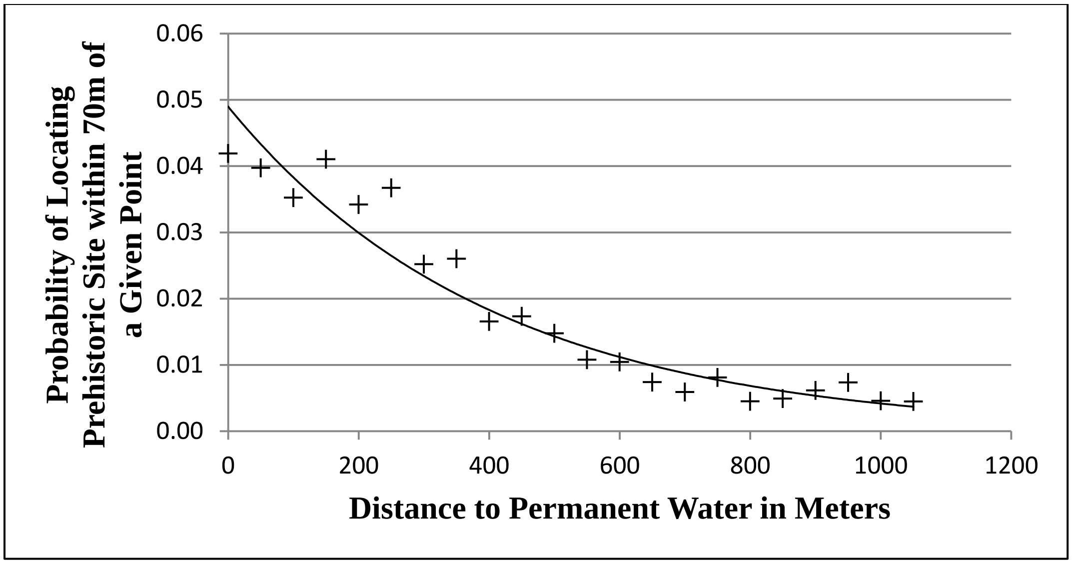


Figure 19-1. Probability of an Archaeological Site Existing within 70 Meters of a Given Point at Increasing Distances from a Permanent Water Source in the ARCF Project

Figure 19-1 reflects the empirical probability of an archaeological site occurring within 70 meters of a point located at a given distance from a water source in those portions of the ARCF project area that have been subject to intensive archaeological inventories. These data indicate that archaeological sensitivity drops quickly with increasing distance to water. Though the ARCF data were compiled for a smaller part of the Sacramento River, it is reasonable to expect a generally similar pattern of land use throughout the overall system. The spectrum of linguistic and cultural variability throughout prehistoric California was broad and vibrant, but patterns of adaptation were remarkably consistent between culturally distinct groups, especially in the Central Valley.

The Area of Potential Effect (APE) for the proposed levee repairs would likely extend no more than 400 meters from the river and in most cases would be located within 100 meters of the river. Using this figure, we can divide the total length of proposed levee (approximately 20,800 meters) by 70 and multiply that by the probability of encountering a site at 100 meters (approximately 0.035). This predicts that at least 11 prehistoric sites would be encountered within the course of the proposed program within construction APEs. The noncontiguous nature of this proposed program may increase or decrease the likelihood of sites within a repair area because this prediction is based on the overall length of the program. Considering the average length of current sites within the program area (approximately 335 meters), there is a 17% chance that a prehistoric site would be found in any given repair area. This model does not include the likelihood of encountering historic sites or structures; however 97 are known to be within the program area and others are likely to be identified during the course of proposed program implementation.

Sacramento River Levee System

Due to hydraulic mining in the Sierra Nevada foothills, severe flooding became commonplace in the Central Valley beginning in the 1850s. In response, private landowners began to construct small levees near their farms along the Sacramento River. These 3- to 4-foot-high levees proved to be ineffective and regularly failed during catastrophic floods. The federal Swamp Land Act of 1850 allowed for the state to reclaim wetlands through construction of levees. The reclamation program, however, was ineffective due to corruption and other problems. In 1864, the state legislature enhanced the power of local levee districts in order to spur more levee construction, though political battles were still being waged over who would control these districts. Through the 1880s and 1890s, local levee districts continued to build levees piecemeal. The Flood Control Act was passed by Congress in 1917 (Public Law 64-367, Section 2). The act required the Corps to work with state governments and local levee districts to construct flood control facilities along the Sacramento River and also authorized the Sacramento River Flood Control Project (SRFCP), which provided for construction of more levees as well as the Yolo and Sutter Bypasses. The SRFCP resulted in construction of about 1,000 miles of levees, which are part of the Sacramento River Levee System. The program area encompasses part of this system.

The Sacramento River Levee System as a whole has not been formally evaluated. The system is widely recognized by the federal, state, and local professional cultural resources and historic preservation community as being eligible for listing in the NRHP under Criterion A/1 for the system's role in flood control of the Central Valley, which led to the expansion of early settlements. For the purposes of this study it is assumed that the Sacramento River Levee System would meet both state and federal significance criteria under Criteria A of the NRHP, and, therefore, both the PA and the HPTP outline procedures for the evaluation and treatment during the course of program implementation.

Underwater

Initial analysis of the data collected during dive investigations indicates that three sites examined appear eligible for NRHP and California Register of Historical Resources (CRHR) status. Additionally, several sites may meet eligibility criteria. If any of these potentially significant sites cannot be avoided and would be affected, further investigations would be needed to determine whether the sites meet NRHP and CRHR eligibility as outlined in the PA and HPTP.

Predicted Property Types

Because a considerable portion of the program area has not yet been examined for cultural resources, this section describes the types of resources that are predicted to be present in the program area. The term "property type" refers to a grouping of properties that share similar important characteristics. For the HPTP, property types have been broadly categorized into groups based on their cultural and temporal associations. These two groups are subdivided as discussed below.

Prehistoric Archaeological Property Types

Previous studies in the vicinity of the program area provide reasonable expectations of the range of prehistoric archaeological property types relevant to the proposed program. They are classified here based on constituents and features. Five prehistoric archaeological property types, as defined in the HPTP, have potential to be present in the program area: midden sites, isolated burials and features, lithic scatters, bedrock milling features, and isolated artifacts. Each prehistoric property type is described separately in the HPTP (Attachment 1 of Appendix B).

Native American Property Types

Native American property types, or traditional cultural properties (TCPs), within the program area would be associated with the waterways of the Central Valley. Such properties derive their significance from the role the property plays in the cultural practices or beliefs of an extant community or identifiable social group. Examples of TCPs range from expansive geographic areas such as the Sutter Buttes to individual locations associated with beliefs or practices that are of traditional cultural significance. Examples of TCP types include ceremonial and sacred sites, as well as plant gathering and fishing locations, as described in the HPTP (Attachment 1 of Appendix B).

Historical Archaeological Property Types

The records search identified previous cultural resource studies in the vicinity of the program area that provide reasonable expectations of the range of historical archaeological property types relevant to the proposed program. These property types are classified here in terms of function. Intensive historic-era use of waterways within the program area coincides with the discovery of gold in 1848. The sudden influx of fortune seekers resulted in heavy use of waterways for transportation of individuals and supplies. To accommodate the surge, cities and towns were established along the rivers. Both small- and large-scale mining endeavors were carried out within the program area along the Feather, Bear, Yuba, and American Rivers. Agricultural endeavors followed quickly, and overland transportation routes were developed that often paralleled waterways within the program area. Historical archaeological resources within the program area are mostly related to these events. Five categories of historical archaeological property types, as defined in the HPTP (Attachment 1 of Appendix B), have been identified within the program area: mining sites, building foundations, refuse scatters/dumps, transportation related features, and water conveyance systems.

Historic Structure Property Types

Historic structures include several different property types best classified as buildings, structures, and sites. Property types within these classifications can also be classified as a district. A district would contain a high concentration of buildings, structures, and sites united historically or aesthetically. Cultural landscapes include a combination of property types and are typically classified as either a site or district. The records search identified previous cultural resource studies within the program area that indicate a high concentration of historic structure property types, as defined in the HPTP (Attachment 1 of Appendix B), including buildings, structures, sites, and cultural landscapes.

Submerged Property Types

Previous studies in the vicinity of the program area provide reasonable expectations of the range of submerged property types relevant to the proposed program. These property types are classified here based on function because of the wide variation in form. Submerged resources are typically associated with historic-era activities, although there is a small possibility for submerged prehistoric resources. Use of the waterways within the program area for commercial, military, and recreational endeavors has been intensive since the 1840s, resulting, for various reasons, in numerous submerged properties. The records search revealed previous cultural resources studies within the program area that have identified several submerged property types. Submerged resource property types, as described in the HPTP (Attachment 1 of Appendix B), include the remains of landings, pilings, and historic vessels.

Significance Criteria

Federal

Because there is no federal land in the program area, the Native American Graves Protection and Repatriation Act (NAGPRA) and the Archaeological Resources Protection Act (ARPA) are not applicable. Although NAGPRA and ARPA do not apply to the proposed program, NEPA and Section 106 of the NHPA are applicable.

NEPA

According to the NEPA regulations, in considering whether an action may "significantly affect the quality of the human environment," an agency must consider the following:

- Unique characteristics of the geographic area such as proximity to historic or cultural resources (40 CFR Section 1508.27(b)(3)).
- The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places (40 CFR Section 1508.27(b)(8)).

The NEPA regulations also require that, to the fullest extent possible, agencies must prepare draft environmental impact statements concurrently with and integrated with environmental impact analyses and related surveys and studies required by the NHPA (40 CFR Section 1502.25(a)).

Section 106 of the NHPA

Under Section 106 criteria for the assessment of effects, a project or program may result in a finding of no historic properties affected, no adverse effect on historic properties, or an adverse effect on historic properties (36 CFR Part 800). If the finding indicates that a project or program would have an adverse effect on a historic property, appropriate mitigation is required in consultation with SHPO and other concerned entities. An adverse effect on a historic property is found when an activity may alter, directly or indirectly, any of the characteristics of the historic property that render it eligible for inclusion in the NRHP. The alteration of characteristics is considered an adverse effect if it could diminish the integrity of the historic property's location, design, setting, materials, workmanship, feeling, or association. The assessment of effects on historic properties in the program area would be conducted in accordance with the guidelines set forth in 36 CFR Section 800.5. Under this regulation, adverse effects to historic properties that would be considered significant include, but are not limited to, the following effects.

- Physical destruction of or damage to all or part of the property.
- Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary of Interior's Standards and Guidelines for the Treatment of Historic Properties (36 CFR Part 68).
- Removal of the property from its historic location.
- Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance.

- Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic characteristics.
- Neglect of a property that causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to a Native American tribe.
- Transfer, lease, or sale of the property out of federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

State

According to CEQA, a project that may cause a "substantial adverse change" in the significance of a "historical resource" or a "unique archaeological resource" may have a significant impact on the environment (State CEQA Guidelines Section 15064.5, PRC 21083.2). CEQA defines a "substantial adverse change" as follows:

- Physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historical resource would be materially impaired.
- Demolition or material alteration in an adverse manner of those physical characteristics of a historical resource which convey its historical significance and justify its inclusion in or eligibility for inclusion in the California Register of Historical Resources, inclusion in a local register pursuant to Section 5020.1(k) of the Public Resources Code, or its identification in a historical resources survey meeting the requirements of Section 5024.1(g) of the Public Resources Code.

If a project results in significant effects on historical resources, alternative plans or mitigation measures must be considered.

Eligibility Criteria

Federal

The Federal government is required to consider effects to cultural resources if they qualify as historic properties under the NHPA. Cultural resource importance is evaluated based on eligibility for listing in the NRHP. The NRHP significance criteria applied to evaluate the cultural resources in this study are defined in 36 CFR Part 60.4 as follows:

> [T]he quality of significance in American history, architecture, archaeology, engineering, and culture as present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
>
> A) that are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B) that are associated with the lives of persons significant in our past; or
>
> C) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D) that have yielded, or may be likely to yield, information important in prehistory or history.

As mentioned above, eligibility for listing in the NRHP requires that a resource not only meet one of the significance criteria but also possess “integrity.” Integrity is the ability of a property to convey its significance. The evaluation of a resource’s integrity must be grounded in an understanding of that resource’s physical characteristics and how those characteristics relate to its significance. The evaluation of a resource’s integrity in relation to its significance will be conducted as prescribed in National Register Bulletin No. 15: How to Apply the National Register Criteria for Evaluation (National Park Service 2002).

State

Under CEQA, a cultural resource is considered important if it meets the definition of “historical resource or unique archaeological resource.” PRC Section 5020.1(j)) states:

> “Historical resource” includes, but is not limited to, any object, building, structure, site, area, place, record, or manuscript which is historically or archaeologically significant, or is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California.

Historical resources may be designated as such through three different processes.

- Official designation or recognition by a local government pursuant to local ordinance or resolution (PRC Section 5020.1(k)).
- A local survey conducted pursuant to PRC Section 5024.1(g).
- Listed in or eligible for listing in the NRHP (PRC Section 5024.1(d)(1).

The process for identifying historical resources typically is accomplished by applying the criteria for listing in the CRHR (14 California Code of Regulations [CCR] Section 4852), which states that a historical resource must be significant at the local, state, or national level under one or more of the following four criteria.

- It is associated with events that have made a significant contribution to the broad patterns of California’s history and cultural heritage (Criterion 1).
- It is associated with the lives of persons important in our past (Criterion 2).
- It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master or possesses high artistic values (Criterion 3).
- It has yielded, or may be likely to yield, information important in prehistory or history (Criterion 4).

To be considered an “historical resource” for the purpose of CEQA, the resource must also have integrity, which is the authenticity of a resource’s physical identity evidenced by the survival of characteristics that existed during the resource’s period of significance.

Resources, therefore, must retain enough of their historic character or appearance to be recognizable as historical resources and to convey the reasons for their significance. Integrity is evaluated with regard to the retention of location, design, setting, materials, workmanship, feeling, and association. It also must be judged with reference to the particular criteria under which a resource is eligible for listing in the CRHR (14 CCR Section 4852[c]).

The state also recognizes the importance of “unique archaeological resources” defined in PRC Section 21083.2 as an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria.

- Contains information needed to answer important scientific research questions and for which there is a demonstrable public interest.
- Has a special and particular quality such as being the oldest of its type or the best available example of its type.
- Is directly associated with a scientifically recognized important prehistoric or historic event or person.

In most situations, resources that meet the definition of a unique archaeological resource also meet the definition of historical resource. As a result, it is current professional practice to evaluate cultural resources on their eligibility for listing in the CRHR. For the purposes of this cultural resources study, a resource is considered important if it meets the CRHR eligibility (significance and integrity) criteria.

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, regular operation and maintenance (O&M) of the levee system would continue as presently executed by the local maintaining entities (subject to revision of the governing O&M manual), but construction activities associated with the proposed program would not occur. As a result, erosion would continue and the risk of levee failure and possible catastrophic flooding would increase as more erosion sites become critical and repair is limited to emergency response. Continued erosion and the increased flood risk have the potential to adversely affect historical properties in the program area as a result of the following:

- Continued loss of berm and levee foundation.
- Catastrophic flooding.
- Implementation of bank protection measures similar to the program’s alternatives through emergency actions.

Taking no action would result in incremental damage to the Sacramento River Levee System, a vast network of levees that is assumed eligible for the NRHP under criterion A of 36 CFR Part 60.4 and the CRHR under criterion 1 of 14 CCR Section 4852. Continued erosion, catastrophic flooding and implementation of emergency bank protection measures could result in destruction of cultural resources, including prehistoric and historic cultural resources and human remains that are associated with Native Americans or date to the historic period in California. The cultural resources that would suffer destruction as a result of catastrophic flooding would be much more widespread than those confined to the general program area. Emergency bank protection measures could result in destruction of cultural resources because there would be no lead time to properly identify and protect historic properties or historical resources before measures required for public health and safety would need to be implemented.

However, this alternative would not result in any construction associated with the proposed program and, therefore, would not result in a significant effect on historic properties.

Alternative 2A—Low Maintenance

The following activities associated with Alternative 2A have the potential to adversely affect historical properties in the program area:

Placement of bank fill.

Placement of revetment.

Removal of vegetation on the waterside of existing levees.

Effect CUL-1: Disturbance of Native American or Historic Period Human Remains

The proposed program could result in disturbance of human remains that are associated with Native Americans or date to the historic period in California (the historic period in the Sacramento Valley region is generally considered to range from 1835 to the present). This effect would be significant. Mitigation Measure CUL-MM-1 would reduce the severity of the effect, but it would remain significant and unavoidable.

Mitigation Measure CUL-MM-1: Stop Work if Human Remains Are Discovered

If human remains are discovered during any activities associated with bank protection measures, the Corps and DWR will comply with state and federal laws relating to the discovery and identification of human remains. The Corps and DWR will consult with the most likely descendant of the deceased regarding the disposition of human remains and associated burial items pursuant to the PA as outlined in the HPTP (Attachment 1 of Appendix B). This process includes contacting the coroner and developing a plan for the removal or protection of the remains pursuant to the PA and as outlined in the HPTP (Attachment 1 of Appendix B).

Effect CUL-2: Unavoidable Impacts on Historic Properties or Historical Resources as a Result of Bank Protection Measures

The proposed program may result in adverse effects on historic properties as a result of implementing planned bank protection measures. This effect would be significant, but Mitigation Measure CUL-MM-2 would reduce the effect to a less-than-significant level.

Mitigation Measure CUL-MM-2: Identify Historic Properties and Historical Resources and Implement Treatment Measures for Adverse Effects according to the Historic Properties Treatment Plan

The proposed program will be implemented over a number of years in several phases. The Corps and DWR have determined that implementation of a PA and HPTP is the most effective way to accommodate the program requirements and compliance with NEPA, CEQA, and the NHPA (see Appendix B, Cultural Resources Programmatic Agreement). The PA will allow the incremental documentation and mitigation of adverse effects on historic properties through an identification strategy that is integrated with the planning, design, and ultimate construction of bank protection measures at each repair location when and as that process takes place. This approach allows flexibility in terms of approach and context, as well as specific appropriate treatment measures, as the program and specific geographic locale dictate. General treatment measures are described in the HPTP (Attachment 1 of Appendix B), and include, in order of preference, avoidance (through the establishment of environmentally sensitive areas along the perimeter of the property or through visual screening), preservation in place (through capping or site stabilization), and data recovery. Additional treatment measures are presented that could be used in conjunction with other treatments, such as documentation and public interpretation, and for historic structures, preservation, rehabilitation, restoration, and reconstruction. The HPTP also presents a process for resolving inadvertent discoveries of historic properties.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Activities associated with Alternative 3A that have the potential to adversely affect historical properties in the program area are as follows:

- Construction of setback levees.
- Construction of adjacent levees on the landward side of existing levees.
- Removal of vegetation on the landward side of the existing levee and within the footprint of the new adjacent levee.

Effect CUL-1: Disturbance of Native American or Historic Period Human Remains

Effect CUL-1 is materially the same as described under Alternative 2A. This effect would be significant. Mitigation Measure CUL-MM-1 would reduce the severity of the effect, but it would remain significant and unavoidable.

Effect CUL-2: Unavoidable Impacts on Historic Properties or Historical Resources as a Result of Bank Protection Measures

Effect CUL-2 is materially the same as described under Alternative 2A. This effect would be significant, but Mitigation Measure CUL-MM-2 would reduce the effect to a less-than-significant level.

Effect CUL-3: Loss of Integrity of Character-Defining Elements that Would Qualify the Sacramento River Levee System as a Historic Property or Historical Resource

The proposed program would result in incremental changes to the Sacramento River Levee System, a vast network of levees that is assumed eligible for the NRHP under criterion A of 36 CFR Part 60.4 and the CRHR under criterion 1 of 14 CCR Section 4852. This effect would be significant, but implementation of Mitigation Measure CUL-MM-3 would reduce this effect to a level that is less than significant.

Mitigation Measure CUL-MM-3: Evaluate the Sacramento River Levee System for NRHP Eligibility and Implement Treatment Measures for Adverse Effects According to the Historic Properties Treatment Plan

The proposed program will be implemented over a number of years in several phases. The Corps and DWR have determined that a PA and HPTP is the most effective way to accommodate both the program requirements and compliance with CEQA, NEPA, and the NHPA. The Corps and DWR will implement the HPTP, which outlines a multi-property method for recording, evaluating, and mitigating effects on the levee. The general process for mitigation of adverse effects on the Sacramento River Levee System may include historical documentation and recordation of current conditions.

Alternative 4A—Habitat Replacement (Preferred Alternative)

The following activities associated with Alternative 4A have the potential to adversely affect historical properties in the program area:

- Construction of setback levees.
- Construction of adjacent levees on the landward side of existing levees.
- Removal of vegetation on the landward side of the existing levee and within the footprint of the new adjacent levee.
- Placement of bank fill.
- Placement of revetment.

Effect CUL-1: Disturbance of Native American or Historic Period Human Remains

Effect CUL-1 is materially the same as described under Alternative 2A. This effect would be significant. Mitigation Measure CUL-MM-1 would reduce the severity of the effect, but it would remain significant and unavoidable.

Effect CUL-2: Unavoidable Impacts on Historic Properties or Historical Resources as a Result of Bank Protection Measures

Effect CUL-2 is materially the same as described under Alternative 2A. This effect would be significant, but Mitigation Measure CUL-MM-2 would reduce the effect to a level that is less than significant.

Effect CUL-3: Loss of Integrity of Character-Defining Elements that Would Qualify the Sacramento River Levee System as a Historic Property or Historical Resource

Effect CUL-3 is materially the same as described under Alternative 3A. This effect would be significant, but implementation of Mitigation Measure CUL-MM-3 would reduce this effect to a level that is less than significant.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effects associated with Alternative 5A would be comparable in type to those described above for Alternatives 2A and 3A. Effects CUL-1 through CUL-3 would apply to this alternative, as would Mitigation Measures CUL-MM-1 through CUL-MM-3.

Effect CUL-1: Disturbance of Native American or Historic Period Human Remains

Effect CUL-1 is materially the same as described under Alternative 2A. This effect would be significant. Mitigation Measure CUL-MM-1 would reduce the severity of the effect, but it would remain significant and unavoidable.

Effect CUL-2 Unavoidable Impacts on Historic Properties or Historical Resources as a Result of Bank Protection Measures

Effect CUL-2 is materially the same as described under Alternative 2A. This effect would be significant, but Mitigation Measure CUL-MM-2 would reduce the effect to a less-than-significant level.

Effect CUL-3: Loss of Integrity of Character-Defining Elements that Would Qualify the Sacramento River Levee System as a Historic Property or Historical Resource

Effect CUL-3 is materially the same as described under Alternative 3A. This effect would be significant, but implementation of Mitigation Measure CUL-MM-3 would reduce this effect to a less-than-significant level.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Activities associated with Alternative 4A that have the potential to adversely affect historical properties in the program area are as follows:

- Construction of setback levees.
- Placement of bank fill.
- Placement of revetment.

Effect CUL-1: Disturbance of Native American or Historic Period Human Remains

Effect CUL-1 is materially the same as described under Alternative 2A. This effect would be significant. Mitigation Measure CUL-MM-1 would reduce the severity of the effect, but it would remain significant and unavoidable.

Effect CUL-2: Unavoidable Impacts on Historic Properties or Historical Resources as a Result of Bank Protection Measures

Effect CUL-2 is materially the same as described under Alternative 2A. This effect would be significant, but Mitigation Measure CUL-MM-2 would reduce the effect to a less-than-significant level.

Effect CUL-3: Loss of Integrity of Character-Defining Elements that Would Qualify the Sacramento River Levee System as a Historic Property or Historical Resource

Effect CUL-3 is materially the same as described under Alternative 3A. This effect would be significant, but implementation of Mitigation Measure CUL-MM-3 would reduce this effect to a less-than-significant level.

Chapter 20

Socioeconomics and Environmental Justice

Introduction and Summary

This section describes the environmental setting pertaining to socioeconomics and environmental justice, the determination of effects that would result from implementation of the proposed program, and mitigation measures that would reduce significant effects.

The key sources of data and information used in the preparation of this chapter are listed below.

- U.S. Census Bureau Quick Facts (U.S. Census Bureau 2012).
- Council on Environmental Quality (CEQ), Environmental Justice under the National Environmental Policy Act (NEPA), Guidance for Agencies on Key Terms in Executive Order 12898 (Council on Environmental Quality 1997).
- U.S. Environmental Protection Agency (EPA), Environmental Justice website (U.S. Environmental Protection Agency 2009).

Table 20-1 summarizes the socioeconomic and environmental justice effects resulting from the implementation of the proposed program.

Table 20-1. Summary of Socioeconomic and Environmental Justice Effects

Effect	Mitigation	Implementation Period
SOC-1: Disproportionate Effect on Minority or Low-Income Populations	None required	Not applicable
SOC-2: Temporary Increase in Employment during Construction	None required	Not applicable

Environmental Setting

Existing Conditions

Program Area

This section discusses the affected environment related to socioeconomic and environmental justice in the program area. For the purposes of this chapter, the program area includes all of the counties within the program area as described in Chapter 2. Effects of construction of program alternatives would take place incrementally over several years.

Demographics

In 2011, Caucasians and those of Hispanic or Latino origin comprised the two largest populations in the state, accounting for 74.0% and 38.1% of the population, respectively (U.S. Census Bureau 2012). California's remaining population consisted of American Indians (1.7%), Asians (13.9%), Blacks (6.6%), Pacific Islanders (0.5%), and people who responded "Two or more races" (3.6%) (U.S. Census Bureau 2012).

The race characteristics in the program area are similar to the characteristics of California. In 2011, Caucasians and Hispanics made up the two largest populations in the program area, accounting for 71.5% and 21.5%, respectively. The remaining race categories made up approximately 7% of the population in the program area.

In 2010, the percentage of households below the poverty level in California was 13.7%. This percentage is higher in almost all counties within the program area than the state's overall, with the exception of Placer and Solano counties. Counties within the program area with higher poverty levels than in California overall were Butte (18.4%), Colusa (15.0%), Glenn (17.5%), Sacramento (13.9%), Sutter (14.3%), Tehama (20.3%), Yolo (17.1%), and Yuba (19.2%) counties.

Table 20-2 presents data regarding race and origin by program area counties in 2011, while Table 20-3 presents percentages of households below the poverty level in 2010, also by program area counties. Data presented in these tables are based on data derived from the U.S. Census Bureau's population estimates and income and poverty estimates (U.S. Census Bureau 2012).

Table 20-2. Percentage of Population by Race/Origin Characteristics by County in 2011

	Percentage						
County	White	Black	American Indian	Asian	Pacific Islander	Multiple Races[a]	Hispanic[b]
Butte	87.0	1.8	2.3	4.4	0.3	4.2	14.7
Colusa	92.0	1.1	2.7	1.6	0.5	2.0	56.1
Glenn	90.0	1.2	3.1	2.9	0.2	2.8	38.4
Placer	87.0	1.6	1.1	6.3	0.3	3.8	13.3
Sacramento	65.7	10.9	1.6	15.0	1.1	5.7	22.0
Solano	60.8	15.2	1.2	15.2	1.0	6.5	24.6
Sutter	75.3	2.4	2.3	15.5	0.4	4.1	29.4
Tehama	91.1	0.9	3.3	1.2	0.2	3.3	22.6
Yolo	75.6	3.0	1.9	14.1	0.6	4.8	30.5
Yuba	79.5	3.9	3.1	7.2	0.5	5.9	25.9
California	74.0	6.6	1.7	13.6	0.5	3.6	38.1

[a] People may have chosen to provide two or more races either by checking two or more race response check boxes, by providing multiple write-in responses, or by some combination of check boxes and write-in responses.

[b] People who identify their origin as Spanish, Hispanic, or Latino may be of any race and, therefore, are included in other applicable race categories.

Source: U.S. Census Bureau 2012.

Table 20-3. Percentage of Households below Poverty Level by County and State in 2010

County	% Below Poverty Level[a]
Butte	18.4
Colusa	15.0
Glenn	17.5
Placer	6.6
Sacramento	13.9
Solano	10.4
Sutter	14.3
Tehama	20.3
Yolo	17.1
Yuba	20.0
California	13.7

Source: U.S. Census Bureau 2012

[a] Families and persons are classified as below poverty if their total family income or unrelated individual income was less than the poverty threshold specified for the applicable family size, age of householder, and number of related children under 18 present. The poverty thresholds are updated every year to reflect changes in the Consumer Price Index.

Regulatory Setting

Appendix C, Regulatory Background, describes the federal and state laws, regulations, and policies that pertain to socioeconomic and environmental justice issues within the proposed program area. Pertinent laws, regulations, and policies are listed below.

- Federal:
    - National Environmental Policy Act
    - Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
    - Title VI of the Civil Rights Act
- State:
    - California Environmental Quality Act
    - Government Code Section 65040.12

Determination of Effects

Potential effects on socioeconomic conditions and environmental justice related to construction or operation of the proposed program alternatives are considered at a program level.

Assessment Methods

According to the Council on Environmental Quality's (CEQ's) Guidance for Agencies on Key Terms in Executive Order 12898 (Council on Environmental Quality 1997), the following definitions are used to assess environmental justice effects of the proposed program.

- Minority individuals are defined as members of the following population groups: American Indian or Alaskan Native, Asian or Pacific Islander, Black, or Hispanic.
- Minority populations are identified either:
  - where the minority population percentage of the affected area is meaningfully greater than the minority population percentage of the general population, or
  - where the minority population percentage of the affected area exceeds 50% (Council on Environmental Quality 1997).

For the purposes of this analysis, low-income populations are identified as populations in which either:

- the population percentage below the poverty level is meaningfully greater than that of the population percentage in the general population, or
- the population percentage below the poverty level in the affected area exceeds 50%.

Based on the U.S. Census data presented in Table 20-3, the population percentage below the poverty level is not meaningfully greater than that of the population percentage of the general population in California, nor is the population percentage below the poverty level in the program area greater than 50%.

Significance Criteria

Socioeconomics

For this analysis, an effect pertaining to socioeconomics was considered significant if it would result in a substantial change in employment.

Environmental Justice

CEQ guidance (Council on Environmental Quality 1997:26–27) states that federal agencies are to consider the following three factors to the extent practicable when determining whether environmental effects are disproportionately high and adverse:

- Whether there is or would be an impact on the natural or physical environment that significantly and adversely affects a minority population, or low-income population. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment.
- Whether the environmental effects are significant and are or may be having an adverse impact on minority populations, or low-income populations, which appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group.

- Whether the environmental effects occur or would occur in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Unlike federal law, CEQA does not require an analysis of environmental justice. Therefore, this analysis (i.e., Effect SOC-1: Disproportionate Effect on Minority or Low-Income Populations) does not provide a CEQA finding or conclusion.

Related Analysis

Related issues include the potential displacement of housing and people and growth-inducing effects of the proposed program, which are addressed in Chapters 15 and 22, respectively. In addition, the effects pertaining to loss of agricultural lands and conversion of farmlands to nonagricultural uses is addressed in Chapter 13, Land Use and Agriculture. Therefore, these issues are not discussed further in this chapter.

Effects and Mitigation Measures

Alternative 1—No Action

Under Alternative 1, regular operation and maintenance (O&M) of the levee system would continue as presently executed by the local maintaining entities (subject to revision of the governing O&M manual), but construction activities associated with the proposed program would not occur. Therefore, there would be no potential displacement of homes or residences as a result of levee implementation, or changes in existing population or employment associated with construction of the alternative. As described in Chapter 2, Project Description, erosion would continue under this alternative, and the risk of levee failure and possible catastrophic flooding would increase as more erosion sites become critical and repair is limited to emergency response by federal, state, or local flood control agencies that would eventually implement bank protection along various sites along Sacramento River Flood Control Project levees through emergency action. Emergency repairs would likely result in effects on adjacent agricultural lands and other land uses similar to the proposed program. However, this would likely affect populations of all incomes and races and would not result in a disproportionately high or adverse effect on minority or low-income populations.

Alternative 2A—Low Maintenance

Effect SOC-1: Disproportionate Effect on Minority or Low-Income Populations

A number of rural and urban communities are located in the vicinity of potential bank protection sites and throughout the program area. Alternative 2A entails filling the eroded portion of the bank and installing revetment along the levee slope and streambank from the levee's toe to crest. As described in Chapter 2, Project Description, the purpose and objective of the proposed program is to arrest or avoid streambank erosion that threatens the integrity of the Sacramento River Flood Control Project levee system. Implementing the bank repair and levee rehabilitation alternatives at critical erosion sites would protect property, as well as the health and safety of residents. Therefore, the proposed program would reduce the risk of flooding to existing residential, commercial, and industrial development throughout the program area. While there are low-income and minority populations present throughout the program area, the flood protection benefits of the proposed program would affect all segments of the population in the program area. Without the implementation of proposed bank protection measures at critical erosion sites, increased risk of levee failure and flooding would threaten a large population and substantial improvements in the program area, which spans 10 counties in California, and possibly displace people and residences.

There are known vagrant populations that camp along the program area. The proposed program could displace this population during construction activities by deterring camping activity. Due to the lack of established residences and the wandering nature of these individuals, there is not enough data about this population to draw conclusions about the number of people that could potentially be displaced. Furthermore, any loitering or camping along the river corridors outside of designated campgrounds is typically unlawful [e.g., Sacramento City Code, Title 12 Streets, Sidewalks and Public Places; Yolo County Code, Title 6 Sanitation and Health; Butte County Code, Chapter 24, Section 24-260(a)]. As addressed in more detail in Chapter 13, Land Use and Agriculture, construction of this alternative is not expected to divide an established community. Further, construction-related environmental effects associated with Alternative 2A (e.g., temporary exposure to noise, dust, traffic, and hazardous materials) would occur throughout the program area and take place incrementally. Construction activities associated with Alternative 2A would not result in a disproportionate effect on minority or low-income populations. This effect is considered less than significant.

Effect SOC-2: Temporary Increase in Employment during Construction

Construction activities associated with implementation of this alternative would temporarily increase employment and personal income in the local area, and potentially in all 10 counties within the program area. Although construction would take place incrementally over several years, employment during the construction period would increase directly as a result of the labor needed for construction activities. Employment in the program area would also increase indirectly as personnel involved in construction of the program spend their wages and salaries in the program area.

Therefore, program construction would benefit the local economies within program area counties by temporarily increasing employment and personal income. However, those changes would be minor relative to the total economic activity in program area counties. Construction-related employment would represent a small fraction of total employment and personal income levels. The effect on employment is considered beneficial.

Alternative 3A—Maximize Meander Zone (Environmentally Superior Alternative)

Effect SOC-1: Disproportionate Effect on Minority or Low-Income Populations

This effect would be similar to Alternative 2A in type, but at a potentially greater magnitude due to the greater amount of land required. Alternative 3A involves constructing new setback levees some distance landward of the existing levee, as well as adjacent levees, and would avoid or minimize construction in the stream channel or riparian areas. Therefore, while effects on residents and homes on the waterside may be minimized or avoided, construction of a setback levee or adjacent levee could increase the potential to adversely affect residents and homes on the landside. A setback levee or adjacent levee may be applied anywhere within the program area, but cost, existing land use, and technical issues may limit opportunities.

In addition to public and private docks, businesses, and campgrounds, homes are interspersed among woodlands on the waterside of SRBPP levees. Implementation of Alternative 3A has the potential to displace people and homes, thus requiring the relocation of residences. As addressed in more detail in Chapter 15, Population and Housing, construction of a setback levee or adjacent levee would not require construction of new housing to achieve relocation of residences or to accommodate workers, and would not involve the displacement of a substantial number of people or residences. Any potential relocation of residents would be conducted in compliance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. § 4601 et seq.), the California Relocation Act, and the California Relocation Assistance and Real Property Acquisition Guidelines. Pursuant to these federal and state relocation laws, appropriate compensation would be provided to displaced landowners and tenants, and residents would be relocated to comparable replacement housing. The Relocation Assistance and Real Property Acquisition Guidelines were established by 25 CCR Section 1.6. The guidelines were developed to assist public entities with developing regulations and procedures for implementing 42 USC Section 61, the Uniform Act for federal and federally assisted programs. The guidelines are designed to ensure that uniform, fair, and equitable treatment is given to people displaced from their homes, businesses, or farms as a result of the actions of a public entity.

In addition, bank protection methods would be selected using selection criteria that consider the need to purchase real estate and land use compatibility, among others factors. Regardless of demographic characteristics, it is the intention of the proposed program to avoid displacement of homes whenever possible and such bank repair methods would be proposed only when they are absolutely necessary because of constraints, such as engineering, construction, and the ability of the treatment to provide adequate flood protection for the entire population in the area.

As addressed in more detail in Chapter 13, Land Use and Agriculture, construction of this alternative is not expected to divide an established community. Construction activities associated with Alternative 3A would not result in a disproportionate effect on minority or low-income populations. This effect would be less than significant.

Effect SOC-2: Temporary Increase in Employment during Construction

This effect would be similar to Alternative 2A and would be considered beneficial.

Alternative 4A—Habitat Replacement (Preferred Alternative)

Effect SOC-1: Disproportionate Effect on Minority or Low-Income Populations

This effect would be similar to Alternative 3A in type, but at a lesser magnitude because fewer setback levees and adjacent levees would be constructed. This effect would be considered less than significant.

Effect SOC-2: Temporary Increase in Employment during Construction

This effect would be similar to Alternative 2A and would be considered beneficial.

Alternative 5A—Habitat Replacement Reaching Environmental Neutrality

Effect SOC-1: Disproportionate Effect on Minority or Low-Income Populations

This effect would be similar to Alternative 3A in type, but at a lesser magnitude because fewer setback levees and adjacent levees would be constructed. This effect would be considered less than significant.

Effect SOC-2: Temporary Increase in Employment during Construction

This effect would be similar to Alternative 2A and would be considered beneficial.

Alternative 6A—Habitat Replacement with Vegetation ETL Variance

Effect SOC-1: Disproportionate Effect on Minority or Low-Income Populations

This effect would be similar to Alternative 3A in type, but at a lesser magnitude because fewer setback levees would be constructed. This effect would be considered less than significant.

Effect SOC-2: Temporary Increase in Employment during Construction

This effect would be similar to Alternative 2A and would be considered beneficial.

Chapter 21
Effects of Implementation in Economically Justified Basins Only

As previously discussed in Chapter 2, Project Description, implementation of the proposed program may be influenced by a benefit-cost analysis. In accordance with Corps policy, all water resources projects must have a federal interest and be justified by showing beneficial outputs greater than costs (Engineer Regulation 1105-2-100, Planning Guidance Notebook). While the traditional approach has been to look at the erosion sites in the aggregate (e.g., all 106 sites together), and that approach will likely continue, it is possible that the analysis will look at individual basins or reclamation districts, maintenance areas, or levee districts.

A preliminary analysis has indicated that flood damage reduction in certain less-developed regions (i.e., economic impact areas) in the study area is not likely to meet the benefit-cost criteria. These regions are agricultural areas with few structures. During the implementation phase, it may be difficult to justify bank protection for levees that protect these regions. As a result, bank protection may only be considered justified in some portions of the program area. Accordingly, this EIS/EIR considers a set of alternatives within these "economically justified basins."

In order to account for this possibility, a subset of the 106 sites is analyzed under each action alternative. The subset, or sub-alternative, represents the erosion sites within seven basins that are most likely to satisfy the more restrictive approach to the benefit-cost analysis (also referred to as economically justified basins in this EIS/EIR), as indicated in Table 2-2 in Chapter 2. The proposed action at the individual sites within the seven basins would not change under the sub-alternatives; however, sites outside of the seven basins would not be addressed. As a result, the total number of erosion sites to be addressed, and, therefore, the length of bank protection to be implemented, would be less under the sub-alternative when compared with the corresponding primary alternative (e.g., 2B is a sub-alternative to Alternative 2A, a primary alternative).

Effects associated with each sub-alternative (e.g., 2B, 3B, 4B, 5B, and 6B) were evaluated under each resource and have been found to be comparable in type to those previously described for the corresponding primary alternative (e.g., 2A, 3A, 4A, 5A, and 6A, respectively), but at a lesser magnitude due to the reduced total footprint of the sub-alternative. In every case, the significance determinations for the effects under the sub-alternatives were found to remain the same as for the primary alternatives, and the relevant mitigation measures also apply (Table 21-1).

For those effects that result in a less than significant or beneficial effect, it is logical that the lesser magnitude associated with the sub-alternative would result in the same effect conclusion as that found for the primary alternative. For example, temporary increases in turbidity and suspended solids during construction (Effect WQ-1) would occur under both the primary and sub-alternatives, as would disturbance to or loss of common wildlife species as a result of construction (Effect WILD-3). No situations were identified where a less-than-significant effects determination under the primary alternative changed to a no effect or beneficial conclusion under the sub-alternative. This is due to the nature of the impacts having some level of adverse effect regardless of the scale (e.g., constructing only one site would still have temporary increases in turbidity that would not be considered no effect or a beneficial effect).

Similarly, those effects considered significant under a primary alternative are expected to remain significant under a sub-alternative. While these effects may be less severe under a sub-alternative than a primary alternative, they would still cross the threshold of significance when assessed under the relevant criteria. For example, the loss of special-status plant populations or wildlife species as a result of construction activities would be significant regardless of the number of sites where it happens. Effects on recreation, aesthetics, and cultural resources could also be significant based on actions at a single site if the relevant resource characteristics are present at that site. As a result, the same significance determinations are found for both the primary alternatives and sub-alternatives.

In conclusion, effects associated with each sub-alternative would be comparable in type to those described by each resource in Chapters 4 through 20 for the corresponding primary alternative. Additionally, the significance determinations under each sub-alternative would remain the same as for the primary alternative, and the applicable mitigation measures would also apply (Table 21-1).

Table 21-1. Summary of All Effects and Mitigation Measures, Including Sub-Alternatives

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect FCGEOM-1: Decrease in Levee Erosion and Change in Sediment Recruitment			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	FCGEOM-MM-1: Conduct Site-Specific Studies at Levee Repair Sites and Minimize Changes in Local Hydraulic Conditions through Project Design	Less than significant
Sub-Alternative 2B	Less than significant	FCGEOM-MM-1	Less than significant
Alternative 3A	Less than significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 3B	Less than significant	FCGEOM-MM-1	Less than significant
Alternative 4A	Less than significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 4B	Less than significant	FCGEOM-MM-1	Less than significant
Alternative 5A	Less than significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 5B	Less than significant	FCGEOM-MM-1	Less than significant
Alternative 6A	Less than significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 6B	Less than significant	FCGEOM-MM-1	Less than significant
Effect FCGEOM-2: Increase in Levee Slope Stability			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Beneficial	None required	—
Sub-Alternative 2B	Beneficial	None required	—
Alternative 3A	Beneficial	None required	—
Sub-Alternative 3B	Beneficial	None required	—
Alternative 4A	Beneficial	None required	—
Sub-Alternative 4B	Beneficial	None required	—
Alternative 5A	Beneficial	None required	—
Sub-Alternative 5B	Beneficial	None required	—
Alternative 6A	Beneficial	None required	—
Sub-Alternative 6B	Beneficial	None required	—
Effect FCGEOM-3: Decrease in Instream Woody Material Recruitment			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	FISH-MM-2: Compensate for Loss of Fish Habitat VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat	Less than significant
Sub-Alternative 2B	Significant	FISH-MM-2, VEG-MM-1	Less than significant
Alternative 3A	No effect	FISH-MM-2, VEG-MM-1	—
Sub-Alternative 3B	No effect	FISH-MM-2, VEG-MM-1	—
Alternative 4A	Significant	FISH-MM-2, VEG-MM-1	Less than significant
Sub-Alternative 4B	Significant	FISH-MM-2, VEG-MM-1	Less than significant
Alternative 5A	Significant	FISH-MM-2, VEG-MM-1	Less than significant
Sub-Alternative 5B	Significant	FISH-MM-2, VEG-MM-1	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 6A	Significant	FISH-MM-2, VEG-MM-1	Less than significant
Sub-Alternative 6B	Significant	FISH-MM-2, VEG-MM-1	Less than significant
Effect FCGEOM-4: Changes in Local Hydraulics and Shear Stress			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 2B	Significant	FCGEOM-MM-1	Less than significant
Alternative 3A	Significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 3B	Significant	FCGEOM-MM-1	Less than significant
Alternative 4A	Significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 4B	Significant	FCGEOM-MM-1	Less than significant
Alternative 5A	Significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 5B	Significant	FCGEOM-MM-1	Less than significant
Alternative 6A	Significant	FCGEOM-MM-1	Less than significant
Sub-Alternative 6B	Significant	FCGEOM-MM-1	Less than significant
Effect FCGEOM-5: Minimization of Stream Energy and Associated Floodplain Scour and/or Deposition			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Beneficial	None required	—
Sub-Alternative 3B	Beneficial	None required	—
Alternative 4A	Beneficial	None required	—
Sub-Alternative 4B	Beneficial	None required	—
Alternative 5A	Beneficial	None required	—
Sub-Alternative 5B	Beneficial	None required	—
Alternative 6A	Beneficial	None required	—
Sub-Alternative 6B	Beneficial	None required	—
FCGEOM-6: Substantially Alter the Existing Drainage Pattern of the Site or Area			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Significant	FCGEOM-MM-2: Coordinate with Owners and Operators, Prepare Drainage Studies as Needed, and Remediate Effects through Project Design	Less than significant
Sub-Alternative 3B	Significant	FCGEOM-MM-2	Less than significant
Alternative 4A	Significant	FCGEOM-MM-2	Less than significant
Sub-Alternative 4B	Significant	FCGEOM-MM-2	Less than significant
Alternative 5A	Significant	FCGEOM-MM-2	Less than significant
Sub-Alternative 5B	Significant	FCGEOM-MM-2	Less than significant
Alternative 6A	Significant	FCGEOM-MM-2	Less than significant
Sub-Alternative 6B	Significant	FCGEOM-MM-2	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect WQ-1: Temporary Increase in Turbidity and Suspended Solids during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	WQ-MM-1: Monitor Turbidity during Construction	Less than significant
Sub-Alternative 2B	Significant	WQ-MM-1	Less than significant
Alternative 3A	Significant	WQ-MM-1	Less than significant
Sub-Alternative 3B	Significant	WQ-MM-1	Less than significant
Alternative 4A	Significant	WQ-MM-1	Less than significant
Sub-Alternative 4B	Significant	WQ-MM-1	Less than significant
Alternative 5A	Significant	WQ-MM-1	Less than significant
Sub-Alternative 5B	Significant	WQ-MM-1	Less than significant
Alternative 6A	Significant	WQ-MM-1	Less than significant
Sub-Alternative 6B	Significant	WQ-MM-1	Less than significant
Effect WQ-2: Release of Hazardous Materials to Adjacent Water Body or Groundwater during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than Significant	WQ-MM-2: Implement Measures to Maintain Surface Water and Groundwater Quality	Less than significant
Sub-Alternative 2B	Less than Significant	WQ-MM-2	Less than significant
Alternative 3A	Less than Significant	WQ-MM-2	Less than significant
Sub-Alternative 3B	Less than Significant	WQ-MM-2	Less than significant
Alternative 4A	Less than Significant	WQ-MM-2	Less than significant
Sub-Alternative 4B	Less than Significant	WQ-MM-2	Less than significant
Alternative 5A	Less than Significant	WQ-MM-2	Less than significant
Sub-Alternative 5B	Less than Significant	WQ-MM-2	Less than significant
Alternative 6A	Less than Significant	WQ-MM-2	Less than significant
Sub-Alternative 6B	Less than Significant	WQ-MM-2	Less than significant
Effect GEO-1: Potential Adverse Effects Resulting from Surface Fault Rupture			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	No effect	None required	—
Sub-Alternative 3B	No effect	None required	—
Alternative 4A	No effect	None required	—
Sub-Alternative 4B	No effect	None required	—
Alternative 5A	No effect	None required	—
Sub-Alternative 5B	No effect	None required	—
Alternative 6A	No effect	None required	—
Sub-Alternative 6B	No effect	None required	—
Effect GEO-2: Increase Exposure of People or Structures to Hazards Related to Strong Seismic Ground Shaking			
Alternative 1—No Action	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than Significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect GEO-3: Potential Accelerated Erosion and Sedimentation Resulting from Construction-Related Ground Disturbance			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect GEO-4: Loss of Significant Mineral Resources as a Result of Program Implementation			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect TN-1: Temporary Increase in Traffic Volumes from Construction-Generated Traffic and Potential Degradation of LOS for Roadways in the Vicinity of the Program			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	TN-MM-1: Implement a Traffic Control and Road Maintenance Plan	Less than significant
Sub-Alternative 2B	Significant	TN-MM-1	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 3A	Significant	TN-MM-1	Less than significant
Sub-Alternative 3B	Significant	TN-MM-1	Less than significant
Alternative 4A	Significant	TN-MM-1	Less than significant
Sub-Alternative 4B	Significant	TN-MM-1	Less than significant
Alternative 5A	Significant	TN-MM-1	Less than significant
Sub-Alternative 5B	Significant	TN-MM-1	Less than significant
Alternative 6A	Significant	TN-MM-1	Less than significant
Sub-Alternative 6B	Significant	TN-MM-1	Less than significant
Effect TN-2: Potential Increase in Safety Hazards Attributable to Construction-Generated Traffic			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	TN-MM-1	Less than significant
Sub-Alternative 2B	Significant	TN-MM-1	Less than significant
Alternative 3A	Significant	TN-MM-1	Less than significant
Sub-Alternative 3B	Significant	TN-MM-1	Less than significant
Alternative 4A	Significant	TN-MM-1	Less than significant
Sub-Alternative 4B	Significant	TN-MM-1	Less than significant
Alternative 5A	Significant	TN-MM-1	Less than significant
Sub-Alternative 5B	Significant	TN-MM-1	Less than significant
Alternative 6A	Significant	TN-MM-1	Less than significant
Sub-Alternative 6B	Significant	TN-MM-1	Less than significant
Effect TN-3: Increase Emergency Response Times			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	TN-MM-1	Less than significant
Sub-Alternative 2B	Significant	TN-MM-1	Less than significant
Alternative 3A	Significant	TN-MM-1	Less than significant
Sub-Alternative 3B	Significant	TN-MM-1	Less than significant
Alternative 4A	Significant	TN-MM-1	Less than significant
Sub-Alternative 4B	Significant	TN-MM-1	Less than significant
Alternative 5A	Significant	TN-MM-1	Less than significant
Sub-Alternative 5B	Significant	TN-MM-1	Less than significant
Alternative 6A	Significant	TN-MM-1	Less than significant
Sub-Alternative 6B	Significant	TN-MM-1	Less than significant
Effect TN-4: Potential Inadequate Parking Supply to Meet Parking Demand for Construction Equipment and Construction Workers			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	No effect	None required	—
Sub-Alternative 3B	No effect	None required	—
Alternative 4A	No effect	None required	—
Sub-Alternative 4B	No effect	None required	—
Alternative 5A	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 5B	No effect	None required	—
Alternative 6A	No effect	None required	—
Sub-Alternative 6B	No effect	None required	—
Effect TN-5: Potential Conflict with Alternative Transportation Modes because of Temporary Road Closures			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	TN-MM-1	Less than significant
Sub-Alternative 2B	Significant	TN-MM-1	Less than significant
Alternative 3A	Significant	TN-MM-1	Less than significant
Sub-Alternative 3B	Significant	TN-MM-1	Less than significant
Alternative 4A	Significant	TN-MM-1	Less than significant
Sub-Alternative 4B	Significant	TN-MM-1	Less than significant
Alternative 5A	Significant	TN-MM-1	Less than significant
Sub-Alternative 5B	Significant	TN-MM-1	Less than significant
Alternative 6A	Significant	TN-MM-1	Less than significant
Sub-Alternative 6B	Significant	TN-MM-1	Less than significant
Effect TN-6: Temporary Changes to Navigation			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect TN-7: Potential Rerouting of Roads			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Significant	TN-MM-1	Less than significant
Sub-Alternative 3B	Significant	TN-MM-1	Less than significant
Alternative 4A	Significant	TN-MM-1	Less than significant
Sub-Alternative 4B	Significant	TN-MM-1	Less than significant
Alternative 5A	Significant	TN-MM-1	Less than significant
Sub-Alternative 5B	Significant	TN-MM-1	Less than significant
Alternative 6A	Significant	TN-MM-1	Less than significant
Sub-Alternative 6B	Significant	TN-MM-1	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect AQ-1: Generation of Direct and Indirect Construction Emissions in Excess of Federal *de minimis* Threshold Levels			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	AQ-MM-1a: Apply Applicable Air District's Mitigation Measures to Reduce Construction Emissions below *de minimis* Threshold Levels AQ-MM-1b: Offset Construction-Generated NO_X Emissions to Net Zero (0) for NO_X Emissions in Excess of *de minimis* Thresholds	Significant and unavoidable
Sub-Alternative 2B	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Alternative 3A	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Sub-Alternative 3B	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Alternative 4A	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Sub-Alternative 4B	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Alternative 5A	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Sub-Alternative 5B	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Alternative 6A	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Sub-Alternative 6B	Significant	AQ-MM-1a, AQ-MM-1b	Significant and unavoidable
Effect AQ-2: Generation of Direct and Indirect Operational Emissions in Excess of Federal *de minimis* Threshold Levels			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	AQ-MM-2: Apply Applicable Air District's Mitigation Measures to Reduce Operational Emissions below Federal *de minimis* Thresholds	Less than significant
Sub-Alternative 2B	Significant	AQ-MM-2	Less than significant
Alternative 3A	Significant	AQ-MM-2	Less than significant
Sub-Alternative 3B	Significant	AQ-MM-2	Less than significant
Alternative 4A	Significant	AQ-MM-2	Less than significant
Sub-Alternative 4B	Significant	AQ-MM-2	Less than significant
Alternative 5A	Significant	AQ-MM-2	Less than significant
Sub-Alternative 5B	Significant	AQ-MM-2	Less than significant
Alternative 6A	Significant	AQ-MM-2	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 6B	Significant	AQ-MM-2	Less than significant
Effect AQ-3: Temporary Increase in Construction-Related Emissions in Excess of Applicable Standards			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	AQ-MM-3: Apply Applicable Air District's Mitigation Measures to Reduce Construction Emissions below Applicable Air District's Thresholds	Significant and unavoidable
Sub-Alternative 2B	Significant	AQ-MM-3	Significant and unavoidable
Alternative 3A	Significant	AQ-MM-3	Significant and unavoidable
Sub-Alternative 3B	Significant	AQ-MM-3	Significant and unavoidable
Alternative 4A	Significant	AQ-MM-3	Significant and unavoidable
Sub-Alternative 4B	Significant	AQ-MM-3	Significant and unavoidable
Alternative 5A	Significant	AQ-MM-3	Significant and unavoidable
Sub-Alternative 5B	Significant	AQ-MM-3	Significant and unavoidable
Alternative 6A	Significant	AQ-MM-3	Significant and unavoidable
Sub-Alternative 6B	Significant	AQ-MM-3	Significant and unavoidable
Effect AQ-4: Elevated Health Risks from the Exposure of Nearby Sensitive Receptors to Construction-Related HAPs/TACs			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	AQ-MM-4: Apply Applicable Air District's Mitigation Measures to Reduce HAP/TAC Emissions below the Applicable Air District's HAP/TAC Thresholds	Less than significant
Sub-Alternative 2B	Significant	AQ-MM-4	Less than significant
Alternative 3A	Significant	AQ-MM-4	Less than significant
Sub-Alternative 3B	Significant	AQ-MM-4	Less than significant
Alternative 4A	Significant	AQ-MM-4	Less than significant
Sub-Alternative 4B	Significant	AQ-MM-4	Less than significant
Alternative 5A	Significant	AQ-MM-4	Less than significant
Sub-Alternative 5B	Significant	AQ-MM-4	Less than significant
Alternative 6A	Significant	AQ-MM-4	Less than significant
Sub-Alternative 6B	Significant	AQ-MM-4	Less than significant
Effect AQ-5: Generation of Operational Emissions in Excess of Applicable Standards			
Alternative 1—No Action	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 2A	Significant	AQ-MM-5: Apply Applicable Air District's Mitigation Measures to Reduce Operational Emissions below Applicable Air District's Thresholds	Less than significant
Sub-Alternative 2B	Significant	AQ-MM-5	Less than significant
Alternative 3A	Significant	AQ-MM-5	Less than significant
Sub-Alternative 3B	Significant	AQ-MM-5	Less than significant
Alternative 4A	Significant	AQ-MM-5	Less than significant
Sub-Alternative 4B	Significant	AQ-MM-5	Less than significant
Alternative 5A	Significant	AQ-MM-5	Less than significant
Sub-Alternative 5B	Significant	AQ-MM-5	Less than significant
Alternative 6A	Significant	AQ-MM-5	Less than significant
Sub-Alternative 6B	Significant	AQ-MM-5	Less than significant
Effect AQ-6: Generation of Construction GHG Emissions that May Have a Significant Impact on the Environment			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	AQ-MM-6: Implement Measures to Minimize GHG Emissions from Construction Activities	Significant and unavoidable
Sub-Alternative 2B	Significant	AQ-MM-6	Significant and unavoidable
Alternative 3A	Significant	AQ-MM-6	Significant and unavoidable
Sub-Alternative 3B	Significant	AQ-MM-6	Significant and unavoidable
Alternative 4A	Significant	AQ-MM-6	Significant and unavoidable
Sub-Alternative 4B	Significant	AQ-MM-6	Significant and unavoidable
Alternative 5A	Significant	AQ-MM-6	Significant and unavoidable
Sub-Alternative 5B	Significant	AQ-MM-6	Significant and unavoidable
Alternative 6A	Significant	AQ-MM-6	Significant and unavoidable
Sub-Alternative 6B	Significant	AQ-MM-6	Significant and unavoidable
Effect AQ-7: Generation of Operational GHG Emissions that May Have a Significant Impact on the Environment			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	AQ-MM-6	Significant and unavoidable
Sub-Alternative 2B	Significant	AQ-MM-6	Significant and unavoidable
Alternative 3A	Significant	AQ-MM-6	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 3B	Significant	AQ-MM-6	Significant and unavoidable
Alternative 4A	Significant	AQ-MM-6	Significant and unavoidable
Sub-Alternative 4B	Significant	AQ-MM-6	Significant and unavoidable
Alternative 5A	Significant	AQ-MM-6	Significant and unavoidable
Sub-Alternative 5B	Significant	AQ-MM-6	Significant and unavoidable
Alternative 6A	Significant	AQ-MM-6	Significant and unavoidable
Sub-Alternative 6B	Significant	AQ-MM-6	Significant and unavoidable
Effect NOI-1: Exposure of Sensitive Receptors Adjacent to the Levee Construction Sites to Temporary Construction-Related Noise			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	NOI-MM-1: Employ Noise-Reducing Construction Practices to Comply with Applicable Noise Impact Criteria	Significant and unavoidable
Sub-Alternative 2B	Significant	NOI-MM-1	Significant and unavoidable
Alternative 3A	Significant	NOI-MM-1	Significant and unavoidable
Sub-Alternative 3B	Significant	NOI-MM-1	Significant and unavoidable
Alternative 4A	Significant	NOI-MM-1	Significant and unavoidable
Sub-Alternative 4B	Significant	NOI-MM-1	Significant and unavoidable
Alternative 5A	Significant	NOI-MM-1	Significant and unavoidable
Sub-Alternative 5B	Significant	NOI-MM-1	Significant and unavoidable
Alternative 6A	Significant	NOI-MM-1	Significant and unavoidable
Sub-Alternative 6B	Significant	NOI-MM-1	Significant and unavoidable
Effect NOI-2: Exposure of Sensitive Receptors along Truck Haul Routes to Substantial Temporary Traffic Noise Increases			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect NOI-3: Exposure of Sensitive Receptors to Temporary Construction-Related Vibration			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	NOI-MM-2: Conduct Vibration Monitoring at Buildings within 40 feet of Construction Equipment	Significant and unavoidable
Sub-Alternative 2B	Significant	NOI-MM-2	Significant and unavoidable
Alternative 3A	Significant	NOI-MM-2	Significant and unavoidable
Sub-Alternative 3B	Significant	NOI-MM-2	Significant and unavoidable
Alternative 4A	Significant	NOI-MM-2	Significant and unavoidable
Sub-Alternative 4B	Significant	NOI-MM-2	Significant and unavoidable
Alternative 5A	Significant	NOI-MM-2	Significant and unavoidable
Sub-Alternative 5B	Significant	NOI-MM-2	Significant and unavoidable
Alternative 6A	Significant	NOI-MM-2	Significant and unavoidable
Sub-Alternative 6B	Significant	NOI-MM-2	Significant and unavoidable
Effect NOI-4: Exposure of Sensitive Receptors to Intermittent Noise Due to Long-Term Maintenance Activity including Emergency Repair Activities			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	NOI-MM-1 and NOI-MM-3: Employ Emergency Repair Practices to Reduce Noise Where Feasible	Significant and unavoidable
Sub-Alternative 2B	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable
Alternative 3A	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable
Sub-Alternative 3B	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable
Alternative 4A	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 4B	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable
Alternative 5A	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable
Sub-Alternative 5B	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable
Alternative 6A	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable
Sub-Alternative 6B	Significant	NOI-MM-1 and NOI-MM-3	Significant and unavoidable
Effect VEG-1: Permanent Loss of Woody Riparian Vegetation Resulting from Compliance with the Vegetation ETL			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	VEG-MM-1: Compensate for the Loss of Woody Riparian Habitat. VEG-MM-2: Retain Qualified Botanists to Conduct Floristic Surveys for Special-Status Plants during Appropriate Identification Periods, VEG-MM-3: Redesign Proposed Projects to Avoid Substantial Effects on and/or Transplant Special-Status Plants, and VEG-MM-4: Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel	Significant and unavoidable
Sub-Alternative 2B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Significant and unavoidable
Alternative 3A	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Sub-Alternative 3B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Alternative 4A	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Sub-Alternative 4B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Alternative 5A	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Sub-Alternative 5B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Alternative 6A	No effect	None required	—
Sub-Alternative 6B	No effect	None required	—
Effect VEG-2: Potential Loss of Special-Status Plant Populations as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 2A	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, VEG-MM-5: Install Construction Barrier Fencing to Protect Sensitive Biological Resources Adjacent to the Construction Zone, and VEG-MM-6: Retain a Biological Monitor	Significant and unavoidable
Sub-Alternative 2B	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, VEG-MM-5, *and* VEG-MM-6	Significant and unavoidable
Alternative 3A	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6	Significant and unavoidable
Sub-Alternative 3B	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6	Significant and unavoidable
Alternative 4A	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6	Significant and unavoidable
Sub-Alternative 4B	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6	Significant and unavoidable
Alternative 5A	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, and VEG-MM-5	Significant and unavoidable
Sub-Alternative 5B	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, and VEG-MM-5	Significant and unavoidable
Alternative 6A	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6	Significant and unavoidable
Sub-Alternative 6B	Significant	VEG-MM-2, VEG-MM-3, VEG-MM-4, VEG-MM-5, and VEG-MM-6	Significant and unavoidable
Effect VEG-3: Potential Disturbance or Removal of Riparian Habitat as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Significant and unavoidable
Sub-Alternative 2B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Significant and unavoidable
Alternative 3A	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Sub-Alternative 3B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Alternative 4A	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Sub-Alternative 4B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Alternative 5A	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Sub-Alternative 5B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Alternative 6A	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 6B	Significant	VEG-MM-1, VEG-MM-2, VEG-MM-3, and VEG-MM-4	Less than significant
Effect VEG-4: Loss of Waters of the United States, Including Wetlands, as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7: Redesign Proposed Projects to Avoid and Minimize Effects on Sensitive Biological Resources, and VEG-MM-8: Compensate for the Loss of Wetlands and Other Waters	Less than significant
Sub-Alternative 2B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Alternative 3A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Sub-Alternative 3B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Alternative 4A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Sub-Alternative 4B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Alternative 5A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Sub-Alternative 5B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Alternative 6A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Sub-Alternative 6B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, and VEG-MM-8	Less than significant
Effect VEG-5: Potential Disturbance or Removal of Protected Trees as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-8, VEG-MM-9: Conduct a Tree Survey, and VEG-MM-10: Compensate for the Loss of Protected Trees	Less than significant
Sub-Alternative 2B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-8, VEG-MM-9, and VEG-MM-10	Less than significant
Alternative 3A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-8, VEG-MM-9, and VEG-MM-10	Less than significant
Sub-Alternative 3B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-8, VEG-MM-9, and VEG-MM-10	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 4A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-9, and VEG-MM-10	Less than significant
Sub-Alternative 4B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-9, and VEG-MM-10	Less than significant
Alternative 5A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-8, and VEG-MM-10	Less than significant
Sub-Alternative 5B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-8, and VEG-MM-10	Less than significant
Alternative 6A	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-8, and VEG-MM-10	Less than significant
Sub-Alternative 6B	Significant	VEG-MM-4, VEG-MM-5, VEG-MM-6, VEG-MM-7, VEG-MM-8, and VEG-MM-10	Less than significant
Effect VEG-6: Potential Introduction or Spread of Invasive Plants as a Result of Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	VEG-MM-11: Conduct a Survey to Document Invasive Plant Infestations, VEG-MM-12: Avoid and Minimize the Spread or Introduction of Invasive Plant Species, and VEG-MM-13: Conduct a Follow-Up Weed Survey and Implement Eradication Methods if New Infestations Are Present	Less than significant
Sub-Alternative 2B	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant
Alternative 3A	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant
Sub-Alternative 3B	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant
Alternative 4A	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant
Sub-Alternative 4B	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant
Alternative 5A	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant
Sub-Alternative 5B	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant
Alternative 6A	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant
Sub-Alternative 6B	Significant	VEG-MM-11, VEG-MM-12, and VEG-MM-13	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect VEG-7: Potential Opportunity for Habitat Restoration in Enlarged Floodplain following Program Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Beneficial	None required	—
Sub-Alternative 3B	Beneficial	None required	—
Alternative 4A	Beneficial	None required	—
Sub-Alternative 4B	Beneficial	None required	—
Alternative 5A	Beneficial	None required	—
Sub-Alternative 5B	Beneficial	None required	—
Alternative 6A	Beneficial	None required	—
Sub-Alternative 6B	Beneficial	None required	—
Effect FISH-1: Short-Term Effects of Rock Placement into Nearshore Aquatic Habitat during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	FISH-MM-1: Limit Construction Activity to Periods of the Year That Minimize Effects on Fish	Less than significant
Sub-Alternative 2B	Significant	FISH-MM-1	Less than significant
Alternative 3A	No effect	None required	—
Sub-Alternative 3B	No effect	None required	—
Alternative 4A	Significant	FISH-MM-1	Less than significant
Sub-Alternative 4B	Significant	FISH-MM-1	Less than significant
Alternative 5A	Significant	WQ-MM-1, WQ-MM-2, and FISH-MM-1	Less than significant
Sub-Alternative 5B	Significant	WQ-MM-1, WQ-MM-2, and FISH-MM-1	Less than significant
Alternative 6A	Significant	FISH-MM-1	Less than significant
Sub-Alternative 6B	Significant	WQ-MM-1, WQ-MM-2, and FISH-MM-1	Less than significant
Effect FISH-2: Increases in Sedimentation, Suspended Sediments, and Turbidity during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Sub-Alternative 2B	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Alternative 3A	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Sub-Alternative 3B	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Alternative 4A	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Sub-Alternative 4B	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Alternative 5A	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Sub-Alternative 5B	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Alternative 6A	Significant	WQ-MM-1 and FISH-MM-1	Less than significant
Sub-Alternative 6B	Significant	WQ-MM-1 and FISH-MM-1	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect FISH-3: Spillage and Leakage of Contaminants during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Sub-Alternative 2B	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Alternative 3A	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Sub-Alternative 3B	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Alternative 4A	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Sub-Alternative 4B	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Alternative 5A	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Sub-Alternative 5B	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Alternative 6A	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Sub-Alternative 6B	Significant	FISH-MM-1 and WQ-MM-2	Less than significant
Effect FISH-4: Long-Term Effects on Fish from Loss of Habitat			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	FISH-MM-2 and FISH-MM-3: Compensate for the Loss of Spawning Habitat	Significant and unavoidable
Sub-Alternative 2B	Significant	FISH-MM-2 and FISH-MM-3	Significant and unavoidable
Alternative 3A	Significant	FISH-MM-2 and VEG-MM-1	Less than significant
Sub-Alternative 3B	Significant	FISH-MM-2 and VEG-MM-1	Less than significant
Alternative 4A	Significant	FISH-MM-2, FISH-MM-3, and VEG-MM-1	Less than significant
Sub-Alternative 4B	Significant	FISH-MM-2, FISH-MM-3, and VEG-MM-1	Less than significant
Alternative 5A	Significant	FISH-MM-2, FISH-MM-3, and VEG-MM-1	Less than significant
Sub-Alternative 5B	Significant	FISH-MM-2, FISH-MM-3, and VEG-MM-1	Less than significant
Alternative 6A	Significant	FISH-MM-2, FISH-MM-3, and VEG-MM-1	Less than significant
Sub-Alternative 6B	Significant	FISH-MM-2, FISH-MM-3, and VEG-MM-1	Less than significant
Effect WILD-1: Permanent Loss of Riparian Habitat for Special-Status Wildlife Species Associated with Compliance with the Vegetation ETL			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	VEG-MM-1	Significant and unavoidable
Sub-Alternative 2B	Significant	VEG-MM-1	Significant and unavoidable
Alternative 3A	Significant	VEG-MM-1	Less than significant
Sub-Alternative 3B	Significant	VEG-MM-1	Less than significant
Alternative 4A	Significant	VEG-MM-1	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 4B	Significant	VEG-MM-1	Significant and unavoidable
Alternative 5A	Significant	VEG-MM-1	Significant and unavoidable
Sub-Alternative 5B	Significant	VEG-MM-1	Significant and unavoidable
Alternative 6A	No effect	None required	—
Sub-Alternative 6B	No effect	None required	—
Effect WILD-2: Potential Disturbance or Loss of Special-Status Wildlife Species and Their Habitats as a Result of Program Construction and O&M Activities			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	WILD-MM-1: Document Special-Status Wildlife Species and Their Habitats, WILD-MM-2: Avoid and Minimize Effects on Special-Status Wildlife Species by Redesigning the Action, Protecting Special-Status Wildlife Habitat, and Developing a Mitigation Monitoring Plan (If Necessary),WILD-MM-3: Coordinate with Resource Agencies and Develop Appropriate Wildlife Compensation Plans for Species Listed under ESA and/or CESA, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Significant and unavoidable
Sub-Alternative 2B	Significant	WILD-MM-1, WILD-MM-2, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Significant and unavoidable
Alternative 3A	Significant	WILD-MM-1, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Less than significant
Sub-Alternative 3B	Significant	WILD-MM-1, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Less than significant
Alternative 4A	Significant	WILD-MM-1, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Significant and unavoidable
Sub-Alternative 4B	Significant	WILD-MM-1, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Significant and unavoidable
Alternative 5A	Significant	WILD-MM-1, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Significant and unavoidable
Sub-Alternative 5B	Significant	WILD-MM-1, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 6A	Significant	WILD-MM-1, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Significant and unavoidable
Sub-Alternative 6B	Significant	WILD-MM-1, WILD-MM-3, VEG-MM-1, VEG-MM-4, and VEG-MM-8	Significant and unavoidable
Effect WILD-3: Disturbance to or Loss of Common Wildlife Species as a Result of Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	WILD-MM-4 and WILD-MM-5: Conduct a Preconstruction Survey for Roosting Bats and Avoid or Mitigate Potential Impacts	Less than significant
Sub-Alternative 2B	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Alternative 3A	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Sub-Alternative 3B	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Alternative 4A	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Sub-Alternative 4B	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Alternative 5A	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Sub-Alternative 5B	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Alternative 6A	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Sub-Alternative 6B	Significant	WILD-MM-4 and WILD-MM-5	Less than significant
Effect WILD-4: Disruption to Wildlife Movement Corridors as a Result of Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect LA-1: Physical Division of an Established Community Located Adjacent to the Levee Corridor			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect LA-2: Conflicts with Local Land Use and Agriculture Policies			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect LA-3: Conversion of Important Farmland to Nonagricultural Uses			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Significant	LA-MM-1: Evaluate the Potential for Direct Farmland Conversion at the Project Level and Avoid, Minimize, and Compensate for Loss of Farmland	Significant and unavoidable
Sub-Alternative 3B	Significant	LA-MM-1	Significant and unavoidable
Alternative 4A	Significant	LA-MM-1	Significant and unavoidable
Sub-Alternative 4B	Significant	LA-MM-1	Significant and unavoidable
Alternative 5A	Significant	LA-MM-1	Significant and unavoidable
Sub-Alternative 5B	Significant	LA-MM-1	Significant and unavoidable
Alternative 6A	Significant	LA-MM-1	Significant and unavoidable
Sub-Alternative 6B	Significant	LA-MM-1	Significant and unavoidable
Effect REC-1: Temporary Disruption of Recreational Opportunities during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	REC-MM-1: Notify Recreation Users of Potential Construction Hazards and REC-MM-2: Provide Alternate Recreation Routes	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 2B	Significant	REC-MM-1 and REC-MM-2	Less than significant
Alternative 3A	Significant	REC-MM-1 and REC-MM-2	Less than significant
Sub-Alternative 3B	Significant	REC-MM-1 and REC-MM-2	Less than significant
Alternative 4A	Significant	REC-MM-1 and REC-MM-2	Less than significant
Sub-Alternative 4B	Significant	REC-MM-1 and REC-MM-2	Less than significant
Alternative 5A	Significant	REC-MM-1 and REC-MM-2	Less than significant
Sub-Alternative 5B	Significant	REC-MM-1 and REC-MM-2	Less than significant
Alternative 6A	Significant	REC-MM-1 and REC-MM-2	Less than significant
Sub-Alternative 6B	Significant	REC-MM-1 and REC-MM-2	Less than significant
Effect REC-2: Long-Term Reduction in Quality of Existing Recreational Opportunities within the Levee Corridor			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	VEG-MM-1	Significant and unavoidable
Sub-Alternative 2B	Significant	VEG-MM-1	Significant and unavoidable
Alternative 3A	Significant	VEG-MM-1	Significant and unavoidable
Sub-Alternative 3B	Significant	VEG-MM-1	Significant and unavoidable
Alternative 4A	Significant	VEG-MM-1	Significant and unavoidable
Sub-Alternative 4B	Significant	VEG-MM-1	Significant and unavoidable
Alternative 5A	Significant	VEG-MM-1	Significant and unavoidable
Sub-Alternative 5B	Significant	VEG-MM-1	Significant and unavoidable
Alternative 6A	Significant	VEG-MM-1	Significant and unavoidable
Sub-Alternative 6B	Significant	VEG-MM-1	Significant and unavoidable
Effect REC-3: Temporary Obstruction of Access to Marina or Boat Launch Facilities			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Significant	REC-MM-3: Preserve Marina and Boat Launch Access	Less than significant
Sub-Alternative 3B	Significant	REC-MM-3	Less than significant
Alternative 4A	Significant	REC-MM-3	Less than significant
Sub-Alternative 4B	Significant	REC-MM-3	Less than significant
Alternative 5A	Significant	REC-MM-3	Less than significant
Sub-Alternative 5B	Significant	REC-MM-3	Less than significant
Alternative 6A	Significant	REC-MM-3	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 6B	Significant	REC-MM-3	Less than significant
Effect REC-4: Permanent Loss of Recreational Opportunities			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Significant	REC-MM-4: Rebuild Affected Formal Park Facilities and Trails	Less than significant
Sub-Alternative 3B	Significant	REC-MM-4	Less than significant
Alternative 4A	Significant	REC-MM-4	Less than significant
Sub-Alternative 4B	Significant	REC-MM-4	Less than significant
Alternative 5A	Significant	REC-MM-4	Less than significant
Sub-Alternative 5B	Significant	REC-MM-4	Less than significant
Alternative 6A	Significant	REC-MM-4	Less than significant
Sub-Alternative 6B	Significant	REC-MM-4	Less than significant
Effect REC-5: Safety Hazards to Recreationists			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	No effect	None required	—
Sub-Alternative 3B	No effect	None required	—
Alternative 4A	Significant	REC-MM-5: Hazard-Reducing Placement of Instream Woody Mat	Less than significant
Sub-Alternative 4B	Significant	REC-MM-5	Less than significant
Alternative 5A	Significant	REC-MM-5	Less than significant
Sub-Alternative 5B	Significant	REC-MM-5	Less than significant
Alternative 6A	Significant	REC-MM-5	Less than significant
Sub-Alternative 6B	Significant	REC-MM-5	Less than significant
Effect POP-1: Displace a Substantial Number of Existing Housing Units or a Substantial Number of People, Necessitating Construction of Replacement Housing Elsewhere			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Effect PUB-1: Potential for Damage of Utility Infrastructure and Disruption of Service during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	PUB-MM-1: Verify Utility Locations, Coordinate with Utility Providers, Prepare and Implement a Response Plan, and Conduct Worker Training	Less than significant
Sub-Alternative 2B	Significant	PUB-MM-1	Less than significant
Alternative 3A	Significant	PUB-MM-1	Less than significant
Sub-Alternative 3B	Significant	PUB-MM-1	Less than significant
Alternative 4A	Significant	PUB-MM-1	Less than significant
Sub-Alternative 4B	Significant	PUB-MM-1	Less than significant
Alternative 5A	Significant	PUB-MM-1	Less than significant
Sub-Alternative 5B	Significant	PUB-MM-1	Less than significant
Alternative 6A	Significant	PUB-MM-1	Less than significant
Sub-Alternative 6B	Significant	PUB-MM-1	Less than significant
Effect PUB-2: Potential Disruption to Irrigation Water Supply			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Significant	PUB-MM-2: Coordinate with Irrigation Water Users Before and During Infrastructure Modifications and Minimize Disruptions to Supply	Less than significant
Sub-Alternative 3B	Significant	PUB-MM-2	Less than significant
Alternative 4A	Significant	PUB-MM-2	Less than significant
Sub-Alternative 4B	Significant	PUB-MM-2	Less than significant
Alternative 5A	Significant	PUB-MM-2	Less than significant
Sub-Alternative 5B	Significant	PUB-MM-2	Less than significant
Alternative 6A	Significant	PUB-MM-2	Less than significant
Sub-Alternative 6B	Significant	PUB-MM-2	Less than significant
Effect VIS-1: Temporary Visual Effects Caused by Construction Activities			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	VIS-MM-1: Install Temporary Visual Barriers between Construction Zones and Residences and Maintain Construction Sites and Staging Areas in an Orderly Fashion	Significant and unavoidable
Sub-Alternative 2B	Significant	VIS-MM-1	Significant and unavoidable
Alternative 3A	Significant	VIS-MM-1	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 3B	Significant	VIS-MM-1	Significant and unavoidable
Alternative 4A	Significant	VIS-MM-1	Significant and unavoidable
Sub-Alternative 4B	Significant	VIS-MM-1	Significant and unavoidable
Alternative 5A	Significant	VIS-MM-1	Significant and unavoidable
Sub-Alternative 5B	Significant	VIS-MM-1	Significant and unavoidable
Alternative 6A	Significant	VIS-MM-1	Significant and unavoidable
Sub-Alternative 6B	Significant	VIS-MM-1	Significant and unavoidable
Effect VIS-2: Substantially Adversely Affect a Scenic Vista			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 3B	Significant	Mitigation not available	Significant and unavoidable
Alternative 4A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 4B	Significant	Mitigation not available	Significant and unavoidable
Alternative 5A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 5B	Significant	Mitigation not available	Significant and unavoidable
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect VIS-3: Substantially Damage Scenic Resources, including, but Not Limited to, Trees, Rock Outcroppings, and Historic Buildings along a Scenic Highway			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 2B	Significant	Mitigation not available	Significant and unavoidable
Alternative 3A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 3B	Significant	Mitigation not available	Significant and unavoidable
Alternative 4A	Significant	Mitigation not available	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 4B	Significant	Mitigation not available	Significant and unavoidable
Alternative 5A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 5B	Significant	Mitigation not available	Significant and unavoidable
Alternative 6A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 6B	Significant	Mitigation not available	Significant and unavoidable
Effect VIS-4: Substantially Degrade the Existing Visual Character or Quality of the Site and Its Surroundings			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 2B	Significant	Mitigation not available	Significant and unavoidable
Alternative 3A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 3B	Significant	Mitigation not available	Significant and unavoidable
Alternative 4A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 4B	Significant	Mitigation not available	Significant and unavoidable
Alternative 5A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 5B	Significant	Mitigation not available	Significant and unavoidable
Alternative 6A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 6B	Significant	Mitigation not available	Significant and unavoidable
Effect VIS-5: Create a New Source of Light or Glare			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 2B	Significant	Mitigation not available	Significant and unavoidable
Alternative 3A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 3B	Significant	Mitigation not available	Significant and unavoidable
Alternative 4A	Significant	Mitigation not available	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 4B	Significant	Mitigation not available	Significant and unavoidable
Alternative 5A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 5B	Significant	Mitigation not available	Significant and unavoidable
Alternative 6A	Significant	Mitigation not available	Significant and unavoidable
Sub-Alternative 6B	Significant	Mitigation not available	Significant and unavoidable
Effect PH-1: Temporary Exposure to or Release of Hazardous Materials during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect PH-2: Exposure of the Environment to Hazardous Materials during Ground-Disturbing Activities			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	WQ-MM-2 and PH-MM-1: Employ a Toxic Release Contingency Plan	Less than significant
Sub-Alternative 2B	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Alternative 3A	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Sub-Alternative 3B	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Alternative 4A	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Sub-Alternative 4B	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Alternative 5A	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Sub-Alternative 5B	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Alternative 6A	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Sub-Alternative 6B	Less than significant	WQ-MM-2 and PH-MM-1	Less than significant
Effect PH-3: Temporary Exposure to Safety Hazards from the Construction Site			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	PH-MM-2: Implement Construction Site Safety Measures and PH-MM-3: Implement an Emergency Response Plan	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 2B	Significant	PH-MM-2 and PH-MM-3	Less than significant
Alternative 3A	Significant	PH-MM-2 and PH-MM-3	Less than significant
Sub-Alternative 3B	Significant	PH-MM-2 and PH-MM-3	Less than significant
Alternative 4A	Significant	PH-MM-2 and PH-MM-3	Less than significant
Sub-Alternative 4B	Significant	PH-MM-2 and PH-MM-3	Less than significant
Alternative 5A	Significant	PH-MM-2 and PH-MM-3	Less than significant
Sub-Alternative 5B	Significant	PH-MM-2 and PH-MM-3	Less than significant
Alternative 6A	Significant	PH-MM-2 and PH-MM-3	Less than significant
Sub-Alternative 6B	Significant	PH-MM-2 and PH-MM-3	Less than significant
Effect PH-4: Exposure of People or Structure to Increased Flood Risk			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Beneficial	None required	—
Sub-Alternative 2B	Beneficial	None required	—
Alternative 3A	Beneficial	None required	—
Sub-Alternative 3B	Beneficial	None required	—
Alternative 4A	Beneficial	None required	—
Sub-Alternative 4B	Beneficial	None required	—
Alternative 5A	Beneficial	None required	—
Sub-Alternative 5B	Beneficial	None required	—
Alternative 6A	Beneficial	None required	—
Sub-Alternative 6B	Beneficial	None required	—
Effect PH-5: Potential for Higher Frequency of Collision between Aircraft and Wildlife			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Significant	PH-MM-4: Design and Manage Habitat Created by Setback Levees Such That It Does Not Attract Wildlife Known to Collide with Aircraft	Less than significant
Sub-Alternative 3B	Significant	PH-MM-4	Less than significant
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Significant	PH-MM-4	Less than significant
Sub-Alternative 5B	Significant	PH-MM-4	Less than significant
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect CUL-1: Disturbance of Native American or Historic Period Human Remains			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	CUL-MM-1: Stop Work if Human Remains Are Discovered	Significant and unavoidable
Sub-Alternative 2B	Significant	CUL-MM-1	Significant and unavoidable

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Alternative 3A	Significant	CUL-MM-1	Significant and unavoidable
Sub-Alternative 3B	Significant	CUL-MM-1	Significant and unavoidable
Alternative 4A	Significant	CUL-MM-1	Significant and unavoidable
Sub-Alternative 4B	Significant	CUL-MM-1	Significant and unavoidable
Alternative 5A	Significant	CUL-MM-1	Significant and unavoidable
Sub-Alternative 5B	Significant	CUL-MM-1	Significant and unavoidable
Alternative 6A	Significant	CUL-MM-1	Significant and unavoidable
Sub-Alternative 6B	Significant	CUL-MM-1	Significant and unavoidable
Effect CUL-2: Unavoidable Impacts on Historic Properties or Historical Resources as a Result of Bank Protection Measures			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Significant	CUL-MM-2: Identify Historic Properties and Historical Resources and Implement Treatment Measures for Adverse Effects according to the Historic Properties Treatment Plan	Less than significant
Sub-Alternative 2B	Significant	CUL-MM-2	Less than significant
Alternative 3A	Significant	CUL-MM-2	Less than significant
Sub-Alternative 3B	Significant	CUL-MM-2	Less than significant
Alternative 4A	Significant	CUL-MM-2	Less than significant
Sub-Alternative 4B	Significant	CUL-MM-2	Less than significant
Alternative 5A	Significant	CUL-MM-2	Less than significant
Sub-Alternative 5B	Significant	CUL-MM-2	Less than significant
Alternative 6A	Significant	CUL-MM-2	Less than significant
Sub-Alternative 6B	Significant	CUL-MM-2	Less than significant
Effect CUL-3: Loss of Integrity of Character-Defining Elements that Would Qualify the Sacramento River Levee System as a Historic Property or Historical Resource			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	No effect	None required	—
Sub-Alternative 2B	No effect	None required	—
Alternative 3A	Significant	CUL-MM-3: Evaluate the Sacramento River Levee System for NRHP Eligibility and Implement Treatment Measures for Adverse Effects According to the Historic Properties Treatment Plan	Less than significant

Alternative	Finding	Mitigation Measure	Finding with Mitigation
Sub-Alternative 3B	Significant	CUL-MM-3	Less than significant
Alternative 4A	Significant	CUL-MM-3	Less than significant
Sub-Alternative 4B	Significant	CUL-MM-3	Less than significant
Alternative 5A	Significant	CUL-MM-3	Less than significant
Sub-Alternative 5B	Significant	CUL-MM-3	Less than significant
Alternative 6A	Significant	CUL-MM-3	Less than significant
Sub-Alternative 6B	Significant	CUL-MM-3	Less than significant
Effect SOC-1: Disproportionate Effect on Minority or Low-Income Populations			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Less than significant	None required	—
Sub-Alternative 2B	Less than significant	None required	—
Alternative 3A	Less than significant	None required	—
Sub-Alternative 3B	Less than significant	None required	—
Alternative 4A	Less than significant	None required	—
Sub-Alternative 4B	Less than significant	None required	—
Alternative 5A	Less than significant	None required	—
Sub-Alternative 5B	Less than significant	None required	—
Alternative 6A	Less than significant	None required	—
Sub-Alternative 6B	Less than significant	None required	—
Effect SOC-2: Temporary Increase in Employment during Construction			
Alternative 1—No Action	No effect	None required	—
Alternative 2A	Beneficial	None required	—
Sub-Alternative 2B	Beneficial	None required	—
Alternative 3A	Beneficial	None required	—
Sub-Alternative 3B	Beneficial	None required	—
Alternative 4A	Beneficial	None required	—
Sub-Alternative 4B	Beneficial	None required	—
Alternative 5A	Beneficial	None required	—
Sub-Alternative 5B	Beneficial	None required	—
Alternative 6A	Beneficial	None required	—
Sub-Alternative 6B	Beneficial	None required	—

Chapter 22
Growth-Inducing and Cumulative Effects

This chapter provides an analysis of both the growth-inducing and cumulative effects that may result from the proposed program.

Growth-Inducing Effects

NEPA and CEQA require that an EIS and EIR discuss how a project, if implemented, could induce growth. This chapter presents an analysis of the potential growth-inducing effects of the proposed program. This chapter contains background information related to growth inducement, the methods used to analyze growth-inducing effects, and the effect conclusions.

Environmental Setting

The information in this section provides context for the analysis to help the reader understand the structure of the analysis.

Growth Projections

Using population projections from the California Department of Finance, the California Department of Housing and Community Development estimated that California's population would grow from 34 million people in 1999 to 45.4 million in 2020 (California Department of Housing and Community Development 2000). On a yearly basis, California's population is expected to grow at a rate of 1.3% per year between 2010 and 2020. Births will provide most of California's projected population growth. Net migration, which accounted for more than half of the state's population growth during the 1980s, is expected to account for a significantly smaller share of 1997–2020 statewide population growth. All but 5% of California's projected population growth is expected to occur in metropolitan areas (California Department of Housing and Community Development 2000). Based on these projections, the population in the program area would continue to increase, and it can be assumed that employment, income, and the demand for housing would also increase.

Current and Planned Development

To accommodate current populations and growth, development has been planned in program area counties in accordance with California law. The key development planning documents are the local general plans for Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties and the cities within these program area counties.

Regulatory Setting

NEPA and CEQA Requirements

Pursuant to 40 Code of Federal Regulations (CFR) Section 1502.16(b), an EIS must include a discussion of the potential indirect effects of a proposed action and their significance. The indirect effects of an action include those that would occur "later in time or farther away in distance, but are still reasonably foreseeable" and "may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate" (40 CFR Section 1508.8(b)).

In addition, Section 21100(b)(5) of CEQA requires an EIR to discuss how a proposed project, if implemented, may induce growth and the impacts of that induced growth (see also State CEQA Guidelines Section 15126). CEQA requires an EIR to discuss specifically "the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment" (State CEQA Guidelines Section 15126.2[d]).

Determination of Effects

An action that removes an obstacle to growth is considered to be growth-inducing. Consequently, where flood risk may be seen as an obstacle to growth in an area, levee improvements that would reduce that risk may be considered to remove an obstacle to growth and, thereby, be indirectly growth-inducing.

Growth inducement may lead to environmental effects, such as increased demand for utilities and public services, increased traffic and noise, degradation of air or water quality, degradation or loss of plant or animal habitats, and conversion of agricultural and open space land to urban uses. Growth within a floodplain area increases the risk to people or property from flooding.

However, if the induced growth is consistent with or provided for by the adopted land use plans and growth management plans and policies for the area affected (e.g., city and county general plans, specific plans, transportation management plans), those plans may ensure that these effects are either less than significant or mitigated to a level that is less than significant. In some instances, significant and unavoidable effects would result from implementation of land use plans. All effects associated with this planned growth are the responsibility of the city or county in which the growth takes place. Local land use plans provide for land use development patterns and growth policies that encourage orderly urban development supported by adequate urban public services, such as water supply, roadway infrastructure, sewer services, and solid waste services.

Effects and Mitigation Measures

No Action Alternative

Under Alternative 1—No Action, the Corps would not implement bank protection along Sacramento River Flood Control Project (SRFCP) levees. The result is likely to be the continued gradual or sporadic loss of remnant floodplain (berm) and the riparian vegetation it supports. Ultimately the erosion could encroach into the cross-section of the levee foundation, creating critical erosion sites. It is possible that federal or state flood control agencies or local maintaining agencies eventually would implement bank protection at various sites along SRFCP levees through emergency action. In any case, the risk of levee failure and possibly catastrophic flooding would increase substantially as more erosion sites become critical and repair is limited to emergency response. In addition, the associated risk to human health and safety, property, and the adverse economic effect that serious flooding could cause would continue, and the risk of a catastrophic flood would remain high. The economic analysis performed for the SRBPP Limited Reevaluation Report (LRR) estimated that there are more than 193,000 structures protected by the SRBPP levees. The value of these structures and their contents (in 2012 dollars) is estimated at almost $100 billion. The SRBPP levees also protect more than 590,000 acres of agricultural land from flooding, with a damage potential of up to $630 billion depending on the severity of the flood event.

Despite the likelihood of implementation of repairs led by federal or state agencies, for the purposes of evaluating effects under Alternative 1—No Action, the EIS/EIR assumes that the improvements would not occur. This assumption provides the most conservative approach for disclosure and comparison of potential effects. Therefore, under Alternative 1—No Action, no bank protection would be implemented, flood risk would continue along existing SRFCP levees, and there would no potential for growth inducement in the program area.

Action Alternatives

The action alternatives (Alternatives 2A through 6B) were developed using those bank protection measures considered to reasonably meet the program's purpose, need, and objectives (see Chapter 1, Introduction). Alternatives development also took into consideration an alternative's ability to eliminate significant environmental effects, to reduce effects to less-than-significant levels, and to minimize any contribution to cumulative effects.

Levees within the program area provide flood damage risk reduction for the Sacramento Valley and help convey water flowing from the surrounding mountain ranges to the Delta. The proposed program seeks to identify and remedy through application of proposed bank protection measures, locations with high failure potential. The proposed program would maintain the integrity of the existing SRFCP levee system and, therefore, would not remove any present obstacles for growth.

Growth is part of the planned development of all program area counties. The counties and cities within the program area have general plans under which growth and increases in population could lead to effects on air and water quality, water supply, traffic, and noise conditions, and increases the demand for such public services as schools, fire, police, sewer, solid waste disposal, and electrical and gas utilities. The expansion of such services could result in significant effects. The effects of this growth have been analyzed in the CEQA documents associated with these plans. Mitigation measures that would reduce or eliminate these effects are included. Ultimately, the effects associated with growth in Sutter and Butte counties are the responsibility of cities and counties in which they occur, in combination with specific project proponents.

While growth in program area counties may occur in the future under their respective approved general plans, the proposed program would not influence such growth because it would not remove any current obstacle to growth, does not increase flood protection (it maintains existing flood protection), and would not directly facilitate growth (like developing new water supply, utilities, or other infrastructure). Therefore, implementation of the action alternatives (i.e., the proposed program) would have no significant effect on growth.

Cumulative Effects

The cumulative effects analysis determines the combined effect of the proposed program and other closely related, reasonably foreseeable, projects. This section introduces the methods used to evaluate cumulative effects, lists related projects and describes their relationship to the project, and identifies cumulative effects by resource area.

Approach to Cumulative Effects Analysis

Legal Requirements

Both the CEQ NEPA implementing regulations and the State CEQA Guidelines require lead agencies to evaluate a proposed project's potential to contribute to a cumulative effect in the project area. Analysis of cumulative effects is needed to ensure that the project's effects are considered thoroughly in the context of effects resulting from other similar, related, and neighboring projects.

The State CEQA Guidelines define *cumulative effects* as two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts (State CEQA Guidelines Section 15355). Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time (State CEQA Guidelines Section 15355[b]). The cumulative effects of a project are to be addressed if the project's incremental effect is cumulatively considerable, meaning that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects (State CEQA Guidelines Sections 15130[a][2] and 15065[a][3]).

Under NEPA, a cumulative effect is to be addressed if it is expected to be significant. The CEQ NEPA guidelines (40 Code of Federal Regulations [CFR] Section 1508.7) define a *cumulative effect* as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

For the purpose of this joint CEQA/NEPA analysis, the NEPA terminology is primarily used, and cumulative impacts are identified as significant or less than significant. For CEQA purposes, a significant impact is also one to which the project's contribution is considerable.

The discussion of cumulative effects need not provide as much detail as the discussion of effects attributable to the project alone. According to the State CEQA Guidelines Section 15130, the level of detail should be guided by what is practical and reasonable, and CEQ suggests that analysis should focus on truly meaningful effects. For those effects for which cumulative effects are identified, the contribution of the proposed project is evaluated to consider whether mitigation measures are available to reduce the potential effect. In cases where no cumulative effects are identified or when the proposed project would have no or only limited contribution to the cumulative effect, the potential effect is addressed briefly to the extent needed to support the effects conclusion.

Methods

According to State CEQA Guidelines Section 15130, an adequate discussion of significant cumulative effects should contain:

- An analysis of related future projects or planned development that would affect resources in the project area similar to those affected by the proposed project.
- A summary of the expected environmental effects to be produced by those projects with specific reference to additional information stating where that information is available.

- A reasonable analysis of the cumulative effects of the relevant projects. An EIR must examine reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects.

To identify the related projects, State CEQA Guidelines Section 15130[b] recommends either the list or projection approach. This analysis uses the list approach, which entails listing past, present, and probable future projects producing related or cumulative effects, including projects outside the control of USACE or CVFPB.

According to CEQ regulations, when determining the scope of the action assessment, similar actions must be considered. Similar actions are defined as actions that, when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography. An agency might want to analyze these actions in the same environmental assessment. It should do so when the best way to adequately assess the combined effects of similar actions or reasonable alternatives to such actions is to address them in a single environmental assessment (40 CFR Section1508.25[a][3]) (Council on Environmental Quality 1997). NEPA does not provide specific guidance regarding how to conduct a cumulative effect assessment; however, the list approach has been effective for disclosing cumulative effects under NEPA.

This analysis considers projects that have common timing and geography and have the potential to affect the same environmental resources as would the proposed program.

Projects Considered for the Cumulative Assessment

A list of past, current, and probable future projects was compiled for the cumulative setting. Some of these projects are more applicable to the cumulative assessment than others. A list of generally applicable projects is shown in Table 22-1. Following Table 22-1 is a narrative description of the most applicable projects (some of which reference back to descriptions in Chapter 1). These projects (cumulative projects) include other flood management projects affecting the Sacramento River and its tributaries, recreation projects in the region, restoration and other water-related projects in and near the program area that could affect fish or vegetation on or adjacent to SRBPP levees, or other activities that could result in effects and benefits similar to those of the proposed project.

Table 22-1. Plans, Projects, and Programs Included in the Cumulative Effects Analysis

Agency	Programs, Projects, and Policies	Comments
Department of Fish and Game	California Aquatic Invasive Species Draft Rapid Response Plan	Program under development. Draft Plan issued in 2007.
Department of Fish and Game	Fremont Landing Conservation Bank	Project completed.
Department of Fish and Game	Fish Screen Project at Sherman and Twitchell Islands	Program included in Delta Initiatives List.
Department of Parks and Recreation	Central Valley Vision	Implementation Plan completed in 2009.
Department of Water Resources	Dutch Slough Tidal Marsh Restoration Project	Project implementation began in 2012. Estimated completion in 2016.
Davis, Woodland, and University of California, Davis	Davis-Woodland Water Supply Project	Project under development. Final EIR in 2009. Specific design and operations criteria not identified.
Water Forum and U.S. Bureau of Reclamation	Lower American River Flow Management Standard	Program under development. Draft EIR in 2010. Recommendations included in NMFS Biological Opinion.
California Department of Fish and Game	Calhoun Cut/ Lindsey Slough Restoration	Increase intertidal marsh habitat and adjacent riparian habitat on 927 acres in Cache Slough ROA.
California Department of Fish and Game	Ecosystem Restoration Program Conservation Strategy	Created in 2000. Ongoing program to preserve, restore, and enhance terrestrial natural communities and ecosystems in the San Francisco Bay and Sacramento-San Joaquin Delta. Protected and restored more than 150,000 acres of habitat, including 3,900 acres and 59 miles of riparian and riverine aquatic habitat (as of 2010) after 7 of the planned 30 years of the project.
California Department of Fish and Game	Lower Sherman Island Wildlife Area Land Management Plan	Ongoing program. Directs habitat and species management on 3,100 acres of marsh and open water.
California Department of Fish and Game	Yolo Bypass Wildlife Area Land Management Plan	Ongoing program. Provides for multiple use management of 16,000 acres of mixed agricultural, grassland and managed wetland habitats.
California Department of Water Resources	FloodSAFE California	Promotes public safety through integrated flood management while protecting environmental resources; emphasizes action in the Delta.
California Department of Water Resources	Levee Repair-Levee Evaluation Program	Ongoing program. Upgrading levees along the Sacramento and San Joaquin Rivers and Delta; 1,600 miles of levees included in Central Valley.
California Department of Water Resources and MOA Partners	Lower Yolo Restoration Project	In Cache Slough ROA, reintroduce tidal action to half of 3,408-acre Yolo Ranch.
Contra Costa Water District	Contra Costa Canal Fish Screen Project	Completed in 2011. Designed to restore Delta ecosystems. Minor terrestrial impact at fish screen sites.

Agency	Programs, Projects, and Policies	Comments
Contra Costa Water District, U.S. Bureau of Reclamation, and California Department of Water Resources	Contra Costa Water District Middle River Intake and Pump Station (Alternative Intake Project)	Completed in 2010. Resulted in permanent conversion of 6–8 acres of rural agricultural land. Features about 12,000 feet of pipe across Victoria Island and under Old River.
National Marine Fisheries Service, U.S. Bureau of Reclamation, and Department of Water Resources	Biological Opinion (BiOp) on the Long-Term Operations of the Central Valley Project and State Water Project	Ongoing program. Action area consists of the Oroville Reservoir, Feather River downstream of Oroville, Sacramento River downstream of Feather River, Sacramento-San Joaquin Delta, and adjacent habitats that are dependent on or influenced by waterways. Designed to conserve freshwater, estuarine, nearshore, and offshore sites. Includes 8,000-acre tidal wetland restoration requirement.
Reclamation District 2093	Liberty Island Conservation Bank	Under implementation. Permits and approvals acquired in 2009. Project site is on northern tip of Liberty Island. Over 160 acres in the project site with about 50 proposed to be converted to open water channels, emergent marsh wetland, and riparian habitat. Focuses on Delta fish habitat but will restore 2.7 acres of riparian habitat.
Semi Tropic Water District	Delta Wetlands	Flood storage and habitat conservation project on three Delta islands.
U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Department of Water Resources and Department of Fish and Game	San Joaquin River Restoration Program	Initiated in 2006. Ongoing program; 150 miles of the river is planned for restoration, including within the BDCP Plan Area.
U.S. Fish and Wildlife Service	Recovery Plan for Sacramento-San Joaquin Delta Native Fishes	Includes developing additional shallow water habitat, riparian vegetation zones and tidal marsh to restore wetland habitats throughout the Bay-Delta ecosystem.

Flood Risk–Reduction Projects

The following descriptions of related or similar flood risk–reduction projects include those that are under active consideration, have been proposed, or have some form of environmental documentation complete. In addition, these projects have the potential to affect the same resources and fall within the same geographic scope and are therefore to be cumulatively considered. In particular, those resources are biological resources (riparian habitat and wildlife disturbance), hydrology, and geomorphology. The geographic scope of consideration for effects on those resources is the Sacramento Valley region/Sacramento River system.

Public Law 84-99 Rehabilitation Assistance of Flood Control Works

Public law 84-99 is described in Chapter 1.

Bay Delta Conservation Plan

The Bay Delta Conservation Plan is described in Chapter 1.

Interagency Flood Maintenance Collaborative Program

The Interagency Flood Maintenance Collaborative is described in Chapter 1.

California Levee Stability Program

The California Levee Stability Program is described in Chapter 1.

Natomas Levee Improvement Project

The Natomas Levee Improvement Project is described in Chapter 1.

American River Common Features Project

The American River Common Features project is described in Chapter 1.

Delta Levees Flood Protection Program

The Delta Levees Flood Protection Program is described in Chapter 1.

Lower Feather River Corridor Management Program

The Lower Feather River Corridor Management Program is described in Chapter 1.

Levee Repairs Program

The Levee Repairs Program is described in Chapter 1.

Mid-Valley Levee Reconstruction Project

The Mid-Valley Levee Reconstruction Project is described in Chapter 1.

Sacramento River Flood Control System Evaluation

The Sacramento River Flood Control System Evaluation is described in Chapter 1.

Sutter Basin Feasibility Study

The Sutter Basin Feasibility Study is described in Chapter 1.

Feather River West Levee Improvement Project

The Feather River West Levee Improvement Project is described in Chapter 1.

Sacramento–San Joaquin River Basins Comprehensive Study and Central Valley Integrated Flood Management Study

The Sacramento-San Joaquin River Basins Comprehensive Study and Central Valley Integrated Flood Management Study is described in Chapter 1.

State of California Central Valley Flood Protection Plan

The Central Valley Flood Protection Plan is described in Chapter 1.

Yuba Basin Project

The Yuba Basin Project is described in Chapter 1.

Three Rivers Levee Improvement Agency Levee Improvement Program

The Three Rivers Levee Improvement Agency Levee Improvement Program is described in Chapter 1.

West Sacramento General Reevaluation Report

The West Sacramento General Reevaluation Report is described in Chapter 1.

West Sacramento Levee Improvements Program

The West Sacramento Levee Improvements Program is described in Chapter 1.

Upper Yuba River Levee Improvement Project

The Upper Yuba River Levee Improvement Project (UYLIP) constructed additional levee improvements to a segment of the upper Yuba River in Yuba County. The improvements included the installation of slurry walls and seepage berms (from Simpson Lane to the Yuba Goldfields). Previous repairs had occurred on this levee segment, and further studies determined additional work was necessary to provide the level of performance required relative to a 200-year flood event for 40,000 residents in south Yuba County. Environmental review and Section 408 permission for the UYLIP was finalized in 2010, and construction completed at the end of 2011.

Feather River Levee Repair Project

The Feather River Levee Repair Project is a multi-phased flood risk–reduction measure construction program on the east bank of the Feather River. It includes approximately 13 miles of levees within the Three Rivers Levee Improvement Authority area in south Yuba County. Construction of the Feather River Levee Repair Project was completed in 2011. Project features included seepage berms, cutoff walls, and 6-mile setback levee. It reduces flood stages in the river by approximately 1.5 feet and more than 40,000 residents benefit from the provision of a level of performance relative to a 200-year flood event.

Feather River Setback Levee at Star Bend

Levee District No. 1 of Sutter County has constructed the Feather River Setback Levee at Star Bend on the west bank of the Feather River near the eastern boundary of Sutter County. The project replaced a segment of the river's existing levee that constricted floodflows in the river and presented an unacceptably high risk for levee failure because of seepage. Construction of the setback levee removed the constriction and reduced water surface elevations in the region.

Yuba River Basin Project General Reevaluation Report

All of the advanced work described under the Yuba Basin Project is being evaluated by USACE in the Yuba River Basin Project GRR. The scheduled work for the 7.5-mile-long Marysville Ring Levee is the final piece to the entire project. In 2008, USACE approved a "separable element" for Marysville, so that work could begin while the GRR was underway. Construction in Marysville began in 2010 and several additional phases of the project are designed and ready for construction. Both the Marysville element and GRR are in need of additional appropriation for completion.

Sacramento Urban Levee Program

DWR is evaluating sites similar to the USACE's Sacramento River Bank Protection Project. The state will repair 19 critical erosion sites, one of which is in West Sacramento at RM 55.8.

North Delta Flood Control and Ecosystem Restoration Project

The purpose of DWR's proposed North Delta Flood Control and Ecosystem Restoration (North Delta) Project is to implement flood risk-reduction measures in the northeast Delta in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. The North Delta project area includes the North and South Fork Mokelumne Rivers and adjacent channels downstream of I-5 and upstream of the San Joaquin River. Solution components being considered for flood management include bridge replacement, setback levees, dredging, island bypass systems, and island detention systems. The project will include ecosystem restoration and science actions in this area, and improving and enhancing recreation opportunities. In support of the environmental review process, an NOI was prepared and public scoping was held in 2003. An EIR was prepared in 2008, but the project is not currently funded for implementation.

CALFED Levee System Integrity Program

The goal of the CALFED Levee System Integrity Program is to reduce risk to land use and associated economic activities, water supply, agriculture and residential use, infrastructure and the ecosystem from the effects of catastrophic breaching of Delta levees. Estimates predict that 520 miles of levees need modification and maintenance to meet the PL 84-99 standard for Delta levees. The program continues to increase levee stability throughout the Delta.

Delta Islands and Levee Feasibility Study

USACE's Delta Islands and Levee Feasibility Study (Delta Study) addresses ecosystem restoration needs, flood risk management problems, and related water resources in the Delta and Suisun Marsh area. The Delta Study will result in a feasibility report that will make recommendations on construction projects and/or additional studies for authorization by Congress. Periodic agency coordination meetings have been held with associated federal, state, and local agencies.

CALFED Levee Stability Program

The purpose of the CALFED Levee Stability Program is to identify and prioritize potential levee stability projects in the Delta. USACE has prioritized potential projects according to how well they met USACE environmental, economic, and other implementation criteria. The short-term strategy is to move to construction quickly on high priority levee projects in order to address Delta-wide levee system needs. The long-term strategy will be developed through the Delta Study process described above.

South River Pump Station Flood Protection Project

The Sacramento Regional County Sanitation District (SRCSD) owns and operates the South River Pump Station (SRPS) located south of the city of West Sacramento. SRCSD is proposing the South

River Pump Station Flood Protection Project, which consists of constructing a new ring levee with relief wells around the SRPS. The new ring levee is intended to provide 200-year protection for the SRPS site. Three of the proposed borrow sites for the SRPS project are common to the Southport project. The public draft EIR was prepared in April 2012. Construction is expected to begin in 2014.

The Delta Plan

The Delta Plan has been developed by the Delta Stewardship Council (DSC), and is a long-term plan which will be a legally enforceable, comprehensive management plan designed to meet the two co-equal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The Delta Plan generally covers five topic areas and goals: increased water supply reliability, restoration of the Delta ecosystem, improved water quality, reduced risks of flooding in the Delta, and protection and enhancement of the Delta. The DSC does not propose constructing, owning, or operating any facilities related to these five topic areas. Rather, the Delta Plan sets forth regulatory policies and recommendations that seek to influence the actions, activities, and projects of cities and counties and state, federal, regional, and local agencies toward meeting the goals in the five topic areas.

The Delta Plan became final in September, 2013. The Delta Plan could contribute to beneficial cumulative effects by setting forth regulatory policies and recommendations that influence projects in a manner which would improve water quality, water supply reliability, flood risk–reduction, and increase habitat for fish and wildlife species.

Additional Projects Affecting Fish and Wildlife That Use the Program Area

As described in Chapter 11, Fisheries and Aquatic Resources, and Chapter 12, Wildlife, substantial long-term effects on vegetation, fish, and wildlife are related to the removal of vegetation and placement of riprap. Regarding wildlife, this could contribute to a cumulative effect when combined with other projects that adversely affect habitat for wildlife that use the program area vegetation. Regarding fish, this could contribute to a cumulative effect when combined with other projects within the geographic range of the fish that would be affected. Thus, the following projects are considered in the cumulative analysis, even though they are not flood risk–reduction projects, because they could also adversely affect the same species of fish or wildlife that would be affected by vegetation removal and placement of riprap under the proposed program.

CALFED Ecosystem Restoration Program

The goals of the CALFED Ecosystem Restoration Program are to:

- Recover 19 at-risk native species and contribute to the recovery of 25 additional species.
- Rehabilitate natural processes related to hydrology, stream channels, sediment, floodplains and ecosystem water quality.
- Maintain and enhance fish populations critical to commercial, sport, and recreational fisheries.
- Protect and restore functional habitats, including aquatic, upland, and riparian, to allow species to thrive.
- Reduce the negative effects of invasive species and prevent additional introductions that compete with and destroy native species.

- Improve and maintain water and sediment quality to better support ecosystem health and allow species to flourish.

The Ecosystem Restoration Program, which is divided into the Sacramento, San Joaquin, and Delta and Eastside Tributary regions, includes the following kinds of actions:

- Develop and implement habitat management and restoration actions, including restoration of river corridors and floodplains, reconstruction of channel-floodplain interactions, and restoration of Delta aquatic habitats.
- Restore habitat that would specifically benefit one or more at-risk species.
- Implement fish passage programs and conduct passage studies.
- Continue major fish screen projects and conduct studies to improve knowledge of their effects.
- Restore geomorphic processes in stream and riparian corridors.
- Implement actions to improve understanding of at-risk species.
- Develop understanding and technologies to reduce the effects of irrigation drainage on the San Joaquin River and reduce transport of contaminant (selenium) loads carried by the San Joaquin to the Delta and the Bay.
- Implement actions to prevent, control, and reduce effects from non-native invasive species.

Ecosystem Restoration Program actions contribute to cumulative benefits on fish and wildlife species, habitats, and ecological processes.

Long-Term Central Valley Project Biological Opinions

BOs issued by USFWS and NMFS for the Central Valley Project (CVP) and State Water Project (SWP) determined that the existing fish passage structure at Fremont Weir was inadequate to allow normal fish passage at most operational levels of the Sacramento River. As a result, the BOs required the U.S. Bureau of Reclamation and/or DWR to increase inundation of suitable acreage for fish habitat within the Yolo Bypass and to modify operations of the Sacramento Weir or Fremont weir to increase juvenile rearing habitat. The BOs also require restoration of 8,000 acres of tidal marsh habitat in the Delta to benefit Delta smelt and up to 20,000 acres of salmonid habitat restoration. The operations of the SWP and CVP are currently subject to the terms and conditions of these BOs until the new water conveyance infrastructure identified in the BDCP becomes operational. At that time, an integrated BiOp on coordinated long-term operation of the CVP and SWP will be completed by USFWS and NMFS.

Cumulative Effects by Resource

The following section describes the potential contribution to cumulative effects on each resource.

Flood Risk Management and Geomorphic Conditions

The cumulative effects of bank revetment in the program area are primarily related to limiting bank retreat. The effects on limiting bank retreat vary by alternative. Alternative 2A would have the greatest limiting effect on bank retreat while Alternative 3A would provide for maximum potential retreat. Alternatives 4A, 5A, and 6A are generally intermediate in value.

The arrest of continued bank retreat would result in secondary impacts on sediment recruitment, meander migration, point bar formation, and the development of off-channel water bodies, such as oxbow lakes and sloughs (Larsen et al. 1997, 2004; Larsen and Greco 2002). Restricting these processes would also limit IWM recruitment and future riparian forest succession by limiting point bar formation for future riparian vegetation colonization. Numerous reviews and studies over the last three decades have illustrated the key physical and biological roles IWM plays in rivers of all sizes for habitat formation, sediment and organic-matter storage, and bank stability, as well as in maintaining a high degree of spatial heterogeneity (i.e., habitat complexity) in stream channels (Harmon et al. 1986; Bisson et al. 1987; Hicks et al. 1991; Reeves et al. 1991; Lassettre and Harris 2001).

Armoring banks (e.g., by the use of riprap) can alter local hydraulics, which can affect channel morphology and aquatic habitat by increasing nearshore velocities and depths, promoting channel incision and channel narrowing, and increasing sediment transport (Binns and Eiserman 1979; California Department of Fish and Game 1983; California Department of Water Resources 1994; Nunally and Sotir 1994; Shields and Hoover 1991). However, as described in Chapter 4, Flood Control and Geomorphology, individual site designs for erosion sites in the program area that would receive waterside levee repair would be modeled if necessary, and developed in an iterative manner intended to minimize changes in local hydraulic conditions. As a result, armoring banks would not result in any significant hydraulic effects on other subbasins protected as part of the SRFCP. These measures would be consistent with the principles that have guided the management of the SRFCP over the past century.

Construction of setback levees would allow for continued bank retreat of the existing streambanks and levees within the immediate vicinity of the repair (i.e., 50–200 feet landward from the current channel position), thereby promoting potential future sediment recruitment, meander migration, point bar formation, IWM recruitment, and riparian vegetation colonization on the existing banks and the reconnected floodplain areas. However, any existing rock revetment at the outer channel bend situated immediately upstream would potentially continue to inhibit lateral migration into the floodplain. The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers, 2013).

Implementation of the proposed program is not anticipated to contribute to increased development or growth on adjacent lands beyond what could be expected under existing conditions. The proposed program's contribution to cumulative geomorphic effects would be further reduced by the use of proposed program elements, such as increasing IWM and riparian habitat area.

Many of the proposed erosion repair sites within the program area are located adjacent to high, historical SRFCP levees and do not have any adjacent significant floodplain habitat. For this reason, the cumulative effect of the proposed program on geomorphic conditions on the adjacent floodplain in those locations that have already had their positions defined would be less than significant. However, installing revetment in those locations that could still be subject to meaningful stream meander could contribute a significant incremental effect of the proposed program on flood control and geomorphology and be cumulatively considerable.

Table 22-1 and the previous descriptions of projects in the region that may have impacts similar to those of the proposed program provide the context for this cumulative effects analysis. Specific examples of projects in the Sacramento River basin that may contribute to cumulative effects on bank retreat are the Central Valley Flood Protection Plan (California Department of Water Resources

2012) and the Bay Delta Conservation Plan (California Department of Water Resources, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service, 2013). General reevaluation studies currently being conducted by the Corps on the American River Common Features project and the West Sacramento projects may also lead to actions that contribute to cumulative effects on bank retreat.

The primary goal of the Central Valley Flood Protection Plan is to reduce the chance of flooding and flood damage by identifying and implementing structural and non-structural projects and actions and to formulate standards and guidelines to facilitate that implementation. Promoting ecosystem functions is one of the plan's supporting goals. Plan development included the review of levees within the Central Valley and the identification of performance problems. The broad plan is now undergoing two basin-wide feasibility studies (one for the Sacramento Valley and one for the San Joaquin Valley) to identify more site-specific actions. Although specific actions are not yet identified, plan implementation could result in increased or decreased bank retreat.

The Bay Delta Conservation Plan includes several potential water intake structures on the lower Sacramento River that would prevent bank retreat at these sites. However, these sites are already stable so the proposed intakes would not contribute to cumulative bank retreat effects. Additionally, that plan would implement a variety of habitat restoration activities that would include 5,000 acres of riparian habitat restoration within the lower Sacramento River and associated Delta and creation of 30,000 acres of aquatic habitat over the next 15 years. Considering all the projects' impacts and mitigation measures together, the impacts on bank retreat, with respect to all alternatives, would be considered cumulatively significant and may not be fully mitigated to a level that is less than significant.

In addition, global climate change could result in more rainfall runoff and flood flows in the Sacramento River. Evaluation in the Interim Draft Post Authorization Change Report for the Sacramento River Bank Protection Project (HDR 2013) determined that because of the uncertainty in the science of calculating appropriate future flows they would not be quantified. Rather, the future condition hydrology is considered equal to existing condition hydrology. Thus there are no changes in design in response to a new future condition hydrology. With respect to future sea level changes and their effects on the proposed program, the Interim Draft Post Authorization Change Report (HDR 2013) applied EC-1165-2-212 (U.S. Army Corps of Engineers 2011). That evaluation found that sea level rise would not affect the design or cost of the proposed program. However, sea level rise could potentially affect the design or cost of specific sites. Consequently, evaluation and design of individual sites will consider sea level rise. Overall, the climate change effects on the proposed program would be considered less than significant.

Water Quality

The proposed program could affect water quality during construction by increasing turbidity and increasing the potential for accidental release of hazardous materials to surface and groundwater. The effects on water quality vary by alternative. Alternative 3 would have the least potential effect on water quality while Alternatives 2, 4, 5, and 6 would be similar to one another and have the greatest potential effect. Cumulative effects could result from the implementation of projects shown in Table 22-1. The previous descriptions of projects in the region that may have impacts similar to those of the proposed program provide the context for this cumulative effects analysis. If constructed at the same time, these projects could contribute to localized and temporary effects on water quality as a result of ground disturbing activities resulting in increased turbidity or the accidental release of hazardous materials. As described in Chapter 5, Water Quality, several minimization measures, including a SWPPP, would be implemented; turbidity would be monitored during construction to ensure acceptable levels identified by the Central Valley RWQCB are met; and an NPDES permit and/or WDRs would be obtained to limit discharge to surface waters and into the water table. These minimization measures are standard construction practices, and this analysis assumes that other projects also would implement the same or similar measures. Upon completion of construction, no additional effects on water quality would occur as part of the proposed program and the natural function of the program areas would be restored with regard to water quality. Consequently, there would be no significant cumulative effect.

Geology, Seismicity, Soils, and Mineral Resources

The proposed program could result in both beneficial and negative effects on geology, seismicity, soils, and mineral resources. The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers, 2013). While the types of effects would be similar across alternatives, the degree of effects on geology, seismicity, and soils would likely vary by alternative. Because of the programmatic nature of this EIR/EIS, the degree of difference between alternatives cannot be quantified at present; however, the level of effects would be determined during site-specific analysis. There would be no effect on mineral resources and, therefore, no cumulative effects associated with the proposed program. Other earth-moving activities in the program area (as presented in Table 22-1 and the previous descriptions of projects in the region that may have impacts similar to those of the proposed program) could alter the stability of soils, and increase erosion, runoff, and sedimentation as a result of earth moving activities typically associated with flood risk–reduction and habitat restoration projects. Soil stability would be addressed through engineering design of program components, and ground-disturbing activities would be required to stabilize soils upon completion of construction or even between stages of construction. Consequently, no significant cumulative effects are anticipated related to soil stability. A cumulative increase in erosion, runoff, and sedimentation could occur if other improvement projects on the Sacramento River or its tributaries are implemented at the same time. The potential for erosion, runoff, and sedimentation resulting from the proposed program and other projects would be limited by minimization measures and implementation of a SWPPP. Any cumulative effect would be temporary and minimal, and, therefore, less than significant. The proposed program would replace or upgrade existing streambanks and there would be no change in risks attributable to seismicity. The program area is not located within an active seismic area; therefore, any cumulative increase in risk related to groundshaking and/or liquefaction would be less than significant.

Transportation and Navigation

The proposed program could affect traffic and navigation during construction by decreasing level of service (LOS) on local transportation networks, including roads and waterways. However, these effects would be temporary and LOS would be restored following the completion of construction. Effects on transportation and navigation would likely vary by alternative. Because of the programmatic nature of this EIR/EIS, differences in the level of these effects between alternatives cannot be quantified at present; however, the level of effects would be determined during site-specific analysis. Cumulative effects could occur if other projects were constructed at the same time. Table 22-1 and the previous descriptions of projects in the region that may have impacts similar to those of the proposed program provide the context for this cumulative effects analysis. As described in Chapter 7, Transportation and Navigation, a traffic control and road maintenance plan would help reduce effects; however, other projects could exacerbate the reduction of LOS in the program area. If these projects occurred sequentially, the construction-related effects could be drawn out for an extended period. If one local area experiences several large construction projects simultaneously, there could be substantial localized effects. Specifically, cumulative effects would occur if projects would use the same haul routes identified for the proposed program and cause them to operate at an unacceptable LOS. Although the traffic control and road maintenance plan will be implemented to reduce the effects of construction traffic on all haul routes, coordinating with the construction schedules of other large projects in the region is heavily dependent on the ability to make corresponding adjustments. In order to minimize these reductions in LOS, coordination with agencies responsible for any other concurrent projects should occur. It is not known at this time specifically where levee improvements would take place. Consequently, there remains potential for a significant, if only temporary, cumulative effect on LOS in the program area.

Air Quality and Climate Change

Under all alternatives, construction emissions would result from materials delivery, construction equipment activity, and hauling debris away from the program area. The excavation amounts, materials required, acreage disturbed, type and number of construction equipment pieces, haul routes, and duration of construction activities associated with the alternatives are not known at this time. Therefore, it is not possible to make a definite quantitative conformity determination. Consequently, the environmental analysis is programmatic in nature, analyzing the 80,000 LF in its entirety. Because of the programmatic level of analysis, variations in the level of effect by alternative are not distinguished.

As explained above, because the jurisdiction, scale, and construction activities of an individual project are unknown, it is possible that criteria pollutant emissions during construction may not be reduced below the federal *de minimis* and air district thresholds after implementing mitigation measures required by air districts. Therefore, the construction criteria pollutant emissions associated with the proposed program could result in a significant and unavoidable effect on local and regional air quality and could result in cumulatively considerable air quality effects considering other on-going and expected activities in the region. Because maintenance activities would have a smaller scale and shorter duration than the construction activities, operational criteria pollutant emissions associated with the proposed program are expected to be much fewer than the construction emissions and are not expected to exceed federal *de minimis* and air district thresholds. Therefore, emissions from program operation are not expected to result in cumulatively considerable air quality effects.

The proposed program, in combination with other projects and activities in the region, would contribute to a cumulative increase in GHG contaminant emissions due to the nature of GHGs. GHGs accumulate in the atmosphere because of their relatively long lifespan. Even with GHG emissions reduction mitigation that would be incorporated into the proposed program and other projects, this cumulative GHG effect would be significant and unavoidable.

Global climate change could result in more rainfall runoff and flood flows in the Sacramento River Evaluation in the Interim Draft Post Authorization Change Report (HDR 2013) determined that because of the uncertainty in the science of calculating appropriate future flows they would not be quantified. Rather, the future condition hydrology is considered equal to existing condition hydrology. Thus there are no changes in design in response to a new future condition hydrology (see

Chapter 4, Flood Control and Geomorphology). With respect to future sea-level changes and their effects on the proposed program, the Interim Draft Post Authorization Change Report (HDR 2013) applied EC-1165-2-212 (U.S. Army Corps of Engineers 2011). That evaluation found that sea level rise would not affect the design or cost of the proposed program. However, sea level rise could potentially affect the design or cost of specific sites. Consequently, evaluation and design of individual sites will consider sea level rise. Overall, the climate change effects on the proposed program could be considered less than significant.

Noise and Vibration

Some individual construction projects associated with the proposed program could result in substantial increases in noise levels at sensitive receptors during construction, specifically those limited cases where the construction activity takes place in close proximity to dwellings and businesses. Changes in noise levels are expected to be similar among all of the action alternatives. To assess the contribution of the alternatives to cumulative noise and vibration conditions, noise and vibration from construction of the program is evaluated in conjunction with noise and vibration potentially generated by past, present, and reasonably foreseeable future projects within the region and previously described in this chapter (Table 22-1). Those projects in the vicinity of sensitive receptors and occurring at the same time as the proposed program, could result in cumulative effects. Because construction noise would be temporary and highly localized, and would take place incrementally over several years, the effects may be minimized but they could still result in a cumulative effect.

Vegetation and Wetlands

The proposed program would result in direct loss of vegetation, primarily riparian vegetation, from construction and implementation of Engineering Technical Letter 1110-2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures (Vegetation ETL). The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers 2013). The effects on riparian vegetation vary by alternative. With respect to direct riparian vegetation removal (see Tables 10-7 to 10-11) the effects range from a high of 30.67 acres for Alternative 2A to a low of 7.6 acres for Alternative 3A. The other alternatives would have intermediate amounts of vegetation removal; specifically, 24.43 acres for Alternative 6A, 25.22 acres for Alternative 4A, and 18.27 acres for Alternative 5A. The effects are different when the plantable acres created are subtracted from the acres removed. Taking created plantable acres into consideration, Alternative 2A would still impact 30.67 acres because no plantable acres would be created under this alternative. Alternative 6A effects would be reduced to a net of 4.78 acres. The remaining alternatives would all have more plantable acres created than acres of directly removed vegetation. The additional acres created would be 0.33 for Alternative 4A, 19.39 for Alternative 3A and 21.49 for Alternative 5A.

Table 22-1 and the previous descriptions of projects in the region that may have impacts similar to those of the proposed program provide the context for this cumulative effects analysis. Specific examples of projects in the Sacramento River basin that may contribute to cumulative effects on riparian vegetation are the Central Valley Flood Protection Plan (California Department of Water Resources 2012), the Feather River Bank Protection Project (ICF International 2013), and the Bay

Delta Conservation Plan (California Department of Water Resources, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service, 2013).

The primary goal of the Central Valley Flood Protection Plan is to reduce the chance of flooding and flood damage by identifying and implementing structural and nonstructural projects and actions and to formulate standards and guidelines to facilitate that implementation. Promoting ecosystem functions is one of the plan's supporting goals. Plan development included the review of levees within the Central Valley and the identification of performance problems. The broad plan is now undergoing two basin-wide feasibility studies to identify more site-specific actions (one for the Sacramento Valley and one for the San Joaquin Valley). Although specific actions are not yet identified, the plan does incorporate the Vegetation ETL and implementation could result in increased effects on riparian vegetation.

The Feather River West Levee Project will implement bank protection measures on the west side levee of the Feather River and will have effects very similar to those of the proposed program, including riparian vegetation impacts. The Feather River West Levee Project also incorporates the Vegetation ETL. Identified mitigation measures would reduce these effects with a goal of no net loss. The Bay Delta Conservation Plan would have some direct riparian vegetation impacts but includes 5,000 acres of riparian habitat restoration within the lower Sacramento River and associated Delta. Implementation of the Vegetation ETL could result in some increased effects on riparian vegetation. Considering all the projects' impacts and mitigation measures together, the cumulative impacts on riparian vegetation, with respect to all SRBPP alternatives, would be considered cumulatively significant and may not be fully mitigated to a level that is less than significant, at least in the mid- to upper Sacramento River system.

Fisheries and Aquatics

The proposed program would result in direct loss of channel margin and associated riparian shade habitat because of construction of the bank protection measures and implementation of the Vegetation ETL. The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers, 2013). The effects on fish and aquatic species vary by alternative. Impacts by alternative on listed species as determined by SAM analysis are provided in Figures 11-1 through 11-5 in Chapter 11, and are detailed by region in Appendix F, Figures F-1 through F-24. To summarize impacts here, listed salmonids are chosen because changes in nearshore habitat associated with proposed measures are very relevant to salmonids and their various life stages when present in the system. Alternative 2A would have the largest effect on salmonids, resulting in the loss of 14,151 linear feet of channel margin. Alternative 6A would have the second largest effect, with a loss of 2,320 linear feet of channel margin. Alternative 4A would result in the loss of 1,241 linear feet of channel margin, while Alternatives 3A and 5A would result in the loss of 653 and 652 linear feet, respectively.

A number of other activities, including hatchery operations, timber harvest, recreation, and urban and rural development, could potentially affect listed fish species in the Sacramento River Basin. Levee maintenance activities by federal and state agencies and local maintaining agencies are likely to continue. Ongoing activities such as levee maintenance that affect fish species, such as salmonids, green sturgeon, and delta smelt, and their habitat will likely continue in the short-term at intensities similar to those of recent years. However, some activities associated with the state's Central Valley Flood Protection Plan and state or local efforts to implement the Vegetation ETL could result in increased effects on fish species. The extent and pace of those activities are not yet known.

Cumulative effects may also include non-federal rock revetment projects carried out by state or local agencies. These types of actions are possible at many locations throughout the program area, but are not included as part of the proposed program.

Potential cumulative effects on fish may also result from any continuing or future diversions of water that remove adult or larval fish from water bodies by entrainment or that may incrementally decrease river flows, thus affecting overall habitat conditions for these species. Reductions in shoreline habitat from the proposed program and other flood control projects and reduced flows and increased entrainment from water diversions could all combine into cumulative effects on fish that migrate throughout the system during their various life stages. Water diversions through intakes serving numerous small, private agricultural lands and duck clubs in the Delta, upstream of the Delta, and in Suisun Bay also contribute to these cumulative effects. These diversions also include municipal and industrial uses and power production. Several new diversions are in various stages of action. The introduction of exotic species may also occur under numerous circumstances. Exotic species can displace native species that provide food for larval fish.

Additional potential cumulative effects could result from wave action in the water channel caused by boats that may degrade riparian and wetland habitat and erode banks; dumping of domestic and industrial garbage; land uses that result in increased discharges of pesticides, herbicides, oil, and other contaminants; and conversion of riparian areas for urban development.

The proposed program would result in direct loss of fish habitat from construction and use of rock revetment as well as implementation of the Vegetation ETL. Implementation of the proposed program and other programs and projects in the region previously described in Table 22-1 could result in cumulatively considerable significant effects. Though Alternatives 3A through 6B include on-site habitat restoration and improvement components (e.g., creation of riparian or wetland benches and placement of IWM), direct loss of habitats would still result because of the construction of bank protection measures. Restoration activities within the general program region could replace some or all of the habitats lost as a result of the proposed program, but there could still be substantial net losses within the program area itself. At a minimum, temporal losses could be substantial because of the time it takes to reestablish riparian vegetation. This would result in cumulatively considerable significant effects on fish habitat that may not be fully mitigated to a level that is less than significant.

Wildlife

The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers, 2013). As described under the Assessment Methods section of Chapter 12, the wildlife effects analysis is qualitative and programmatic and is not based on site-specific information. The discussion regarding the loss of riparian vegetation in Chapter 10, Vegetation and Wetlands, and summarized in that Cumulative Effects section is relevant here because it reflects loss of wildlife habitat. With respect to direct riparian vegetation removal, the effects would range from a high of 30.67 acres for Alternative 2A to a low of 7.6 acres for Alternative 3A (the environmentally superior alternative). The other alternatives would have intermediate amounts of vegetation removal; specifically, 24.43 acres for Alternative 6A, 25.22 acres for Alternative 4A (the preferred alternative), and 18.27 acres for Alternative 5A. The effects are reduced when the plantable acres created are subtracted from the acres removed and that is described in Chapter 10.

The proposed program would result in direct loss of habitats and, thus, associated special-status species as a result of construction and as a result of implementation of the Vegetation ETL. Indirect impacts on special-status species could also occur due to the alternation of habitats, which could result in altered hydrology and reductions in habitat quality due to increases in invasive plants and animals and human and pet disturbances. Implementation of the proposed program along all program area levees could result in cumulatively considerable significant effects. Though Alternatives 3A through 5B include habitat restoration and improvement components (i.e., creation of riparian or wetland benches and placement of IWM), based on the Vegetation ETL, there is expected to be significant losses to riparian habitats and limited opportunities to restore or preserve these habitats within the program area. Because they involve a variance from the Vegetation ETL, Alternatives 6A or 6B would lessen the loss of riparian habitat; however, direct loss of habitats would still occur due to the construction of bank protection measures. Restoration activities within the general program region could replace some of the habitats lost as a result of the proposed program, but there would still be substantial net losses within the program area itself.

Table 22-1 and the previous descriptions of projects in the region that may have impacts similar to those of the proposed program provide the context for this cumulative effects analysis. Specific examples of projects in the region include the Central Valley Flood Protection Plan, the Feather River West Levee Project, the Bay Delta Conservation Plan and state or local efforts to implement the Vegetation ETL could result in increased effects on wildlife species. The Bay Delta Conservation Plan would implement substantial mitigation measures including natural community protection and restoration, seasonally inundated floodplain restoration, grassland natural community restoration and nontidal marsh restoration. These restoration activities within the general program region could replace some or all of the habitats lost as a result of the proposed program, but there could still be net losses because of the time it takes to replace vegetated habitat. This would result in cumulatively considerable significant effects on special-status species dependent on these habitats that may not be fully mitigated to a level that is less than significant.

Land Use and Agriculture

Implementation of any of the alternatives except for 2A and 2B would potentially involve the conversion of Important Farmland in locations throughout the Sacramento Valley and the Delta region to managed grassland through establishment of a vegetation-free zone (VFZ) consistent with the Corps' levee inspections standards on the landward side of the improved levee facilities. Many of the county and local jurisdictions within the program area that support large urban centers have already experienced the conversion of a substantial area of agricultural land to residential and commercial development. These losses would continue an overall trend of net loss of Important Farmland that has been documented in many counties in the program area by the Department of Conservation, which tracks farmland conversions at 2-year intervals under its Farmland Mapping and Monitoring Program. In combination with the conversions of Important Farmland in program area counties associated with past, current, and future projects, the contribution of Alternatives 3A through 6B would be cumulatively significant.

Implementation of Mitigation Measure LA-MM-1 would reduce the contributions of Alternatives 3A through 6B to this cumulative impact; however the effect would remain significant. The contribution of Alternatives 3A through 6B to cumulative conversion of Important Farmland to nonagricultural uses would, therefore, be cumulatively significant and unavoidable.

Recreation

The proposed program would result in mostly short-term effects that would be confined to the construction period. The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers, 2013). Effects on recreation would likely vary by alternative. Because of the programmatic nature of this EIR/EIS, differences in the level of these effects between alternatives cannot be quantified at present; however, the level of effects would be determined during site-specific analysis. Negative effects would result from vegetation removal and other construction activities that could disrupt or temporarily close recreation along levees, bike paths, or other trails. Table 22-1 and the previous descriptions of projects in the region that may have impacts similar to those of the proposed program provide the context for this cumulative effects analysis. These other projects that may affect the same recreation features could result in a cumulative effect on recreation by limiting the availability of the recreation features during construction or altering their use following construction. However, this cumulative effect would be less than significant because effects would be temporary and localized, and other facilities would be available for use during construction. For example, if a shoreline is closed to the public during construction, other shorelines upstream and downstream of the construction sites would remain available. Similarly, if a boat ramp were closed during construction, nearby boat ramps would still be available for use. Recreation features would be restored or rebuilt once construction is completed.

Population and Housing

The effects on population and housing vary by alternative. Alternative 3 would have the greatest potential effect on population and housing while Alternatives 2, 4, 5, and 6 would be similar to one another and have the least potential effect. Other bank protection and flood control projects (including emergency actions), such as those in Table 22-1 and the previous descriptions of projects in the region that may have impacts similar to those of the proposed program, might be constructed in the program area and might have similar potential to displace homes. However, it would be infeasible to predict the number of homes or people affected because the footprints of most of these projects are not yet known, particularly projects that are the result of emergency levee repairs. For the purposes of this analysis, it is assumed that other levee repair projects would also take place incrementally in the future. While there are some flood risk–reduction projects in the region that have removed houses, the number is extremely low. Most of the projects are intended to protect housing and would not remove housing unless there is no practicable alternative to its removal. In those situations, it is typically a single house as opposed to a substantial portion of a community. However, based on analysis of the 106 representative sites and their proximity to existing housing, it is not anticipated that the program would have any cumulatively considerable significant effect by requiring construction of new housing to achieve relocation of residences or to accommodate workers, and would not involve the displacement of a substantial number of people or residences.

Further, any potential relocation of residents would be conducted in compliance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act, the California Relocation Act, and the Relocation Assistance and Real Property Acquisition Guidelines.

Utilities and Public Services

Implementation of the proposed program is not expected to have long-term effects on public utilities. The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers, 2013). Construction of the proposed program may damage drainage and irrigation systems and public utility infrastructure, resulting in temporary disruptions to service. Coordination with drainage and irrigation system users, consultation with service providers, and implementation of appropriate protection measures would minimize the possibility of any significant effects. Effects on irrigation infrastructure and temporary disruptions to local water irrigation water supply would likely vary by alternative. Because of the programmatic nature of this EIR/EIS, these effects cannot be quantified at present; however, the effects would be determined during site-specific analysis. Because utility and public service system effects would be isolated, temporary, and fully mitigated, the proposed program would not result in a cumulative impact to utilities and public services.

Aesthetics

The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers, 2013). The proposed program would have significant cumulative effects in conjunction with existing and proposed levee projects in the region and previously described in Table 22-1. The projects may require that levee slopes be maintained free of woody vegetation in perpetuity, resulting in the loss of a highly valued regional aesthetic landscape component. Effects on aesthetics would likely vary by alternative. Because of the programmatic nature of this EIR/EIS, differences in the level of these effects between alternatives cannot be quantified at present; however, the level of effects would be determined during site-specific analysis. The mature vegetation along the levees is characteristic of the region and is a striking, distinctive element in the landscape. The existing vegetation that is removed would be replaced with herbaceous vegetation. Maintaining the levees void of the characteristic riparian vegetation and mature landscaping, and replacing it with grass and more rock, would highly degrade the visual character and quality of the area and increase glare. Projects in the area would combine to slowly transform the vegetated waterways to channel-like water conveyance ways because erosion is perpetual, and the Vegetation ETL requires future erosion sites to comply with the VFZ. This would lead to the eventual denuding of the waterway and be a severe affect on the visual environment. This effect, when combined with the effects of other past, present, and reasonably foreseeable future actions, would be cumulatively significant.

Public Health

The proposed program has the potential to slightly increase risks to the public during construction through use of equipment and fuels, but the increased risk would be temporary. These risks do not vary substantively between alternatives and would be minimized through implementation of the SWPPP and other best management practices described for Mitigation Measures PH-MM-1 through PH-MM-3 and WQ-MM-2. Because these are standard practice for construction projects, it is expected that other projects would implement the practices, and the overall cumulative effect would be less than significant.

The proposed program would improve flood protection for the program area. Other projects, such as those described in Table 22-1, that reduce stress on levees in the program area could contribute to the beneficial cumulative effect by reducing the overall public risk resulting from levee failure.

Cultural Resources

The amount and locations of existing rock revetment installed under the SRBPP is documented in the recent baseline accomplishments report (U.S. Army Corps of Engineers 2013). The proposed program would cause significant effects on the Sacramento River Levee System, which is assumed eligible for the NRHP under Criterion A of 36 CFR Section 60.4. This would be a significant effect that, when combined with other projects in the region (Table 22-1) that have altered and may alter elements of this system, is considered a significant cumulative effect. The proposed program's effects on cultural resources would likely vary by alternative. Because of the programmatic nature of this EIR/EIS, differences in the level of these effects between alternatives cannot be quantified at present; however, the level of effects would be determined during site-specific analysis. The procedure for mitigation of adverse effects on historic properties has been resolved in a Cultural Resources Programmatic Agreement signed by the Corps, CVFPB and the State Historic Preservation Officers and described in the associated historical properties treatment plan (HPTP) (Attachment 1 of Appendix B).

It is likely that known or unknown cultural resources and human remains could be adversely affected during construction activities for the proposed program. The types of resources in this extensive Sacramento River region are extremely broad and encompass the entire chronology of California history and prehistory. The number of resources in this Sacramento River region is unknown but likely exceeds 750, based on previously recorded sites.

The proposed program's adverse effects on each historic property of the program area would be mitigated pursuant to the Cultural Resources Programmatic Agreement and HPTP (Appendix G). Individual mitigation of effects on specific resources would substantially mitigate the accumulation of effects on historic properties by creating a repository of information about the history and prehistory of the program area, but the effects of the proposed program in combination with the effects of other projects could still result in substantial net losses within the program area. This would result in cumulatively considerable significant effects on cultural resources that may not be fully mitigated to a level that is less than significant.

Socioeconomics and Environmental Justice

Implementation of the proposed program could result in temporary disruptions to local business activities during construction along SRBPP levees. Effects on socioeconomics and environmental justice would likely vary by site and alternative. Because of the programmatic nature of this EIR/EIS, differences in the level of these effects between sites and alternatives cannot be quantified at present; however, the level of effects would be determined during site-specific analysis. Similar projects implemented within the same timeframe as the proposed program and described in Table 22-1 may increase disruptions to businesses, but any temporary disruption is not expected to contribute considerably to a cumulative effect because the disruptions would be short in duration, and very localized and spread out over a very large program area. The proposed program would, however, provide improved regional flood protection as well as provide a temporary increase in employment during construction. Any similar projects implemented within the same timeframe as the proposed program would increase local employment even more, which would be a beneficial cumulative effect.

Chapter 23
Indian Trust Assets

Introduction

Indian Trust Assets (ITAs) are a legal interest in lands, natural resources, money, or other assets held in trust by the United States government or that are restricted against alienation for Indian tribes or individuals. The United States has an Indian trust responsibility to protect and maintain rights reserved by or granted to Indian tribes or individuals by treaties, statues, executive orders, and rights further interpreted by the courts. The Secretary of the Department of the Interior (DOI), acting as the trustee, holds many assets in trust. Some examples of ITAs are lands, minerals, water rights, hunting and fishing rights, titles and money. ITAs cannot be sold, leased, or alienated without the express approval of the United States government.

The Indian trust responsibility requires that all federal agencies take all actions reasonably necessary to protect such trust assets. Executive Order 13175, Consultation with Indian Tribal Governments, and the Department of Defense's American Indian and Alaska Native Policy, signed on October 20, 1998, require that the Corps, as the proposed program's lead federal agency, consult with tribes and assess the impacts of the program on ITAs. If any ITAs are identified and would be impacted, further consultation on measures to avoid or minimize potential adverse effects will take place. If the proposed program results in adverse impacts, consultation regarding mitigation or compensation will take place. Compliance with Executive Order 13007 (Indian Sacred Sites) and the April 29, 1994 Executive Memorandum, Government-to-Government Relations with Native American Tribal Governments, are discussed in Chapter 24, Regulatory Compliance.

Consultation and Determination of Effects

Government-to-Government scoping letters describing the proposed program and inviting consultation were sent to 27 Native American tribes and individuals that have indicated they have interests within the program area by asking to be included on the NAHC's list of contacts for the region. These scoping letters were consistent with the Department of Defense's American Indian and Alaska Native Policy, and based on the California Native American Heritage Commission's list of Native American contacts. A series of phone calls, emails, and two workshops open to Native American groups held in the spring of 2010 were also used to identify any concerns. To date, the Corps has received no tribal concerns regarding the proposed program. No concerns regarding ITAs have been brought to the attention of the Corps.

Additionally, analysis of Native American–owned land in the U.S. Geological Survey's Protected Areas Database (U.S. Geological Survey 2012) shows that there are no Native American–owned or reservation lands within 0.5 miles of the 106 project sites. While Native American–owned and reservation land is not common along the waterways of the program area, it is possible that future unknown project sites could overlap with Native American–owned land. Given the programmatic nature of the current analysis, Native American–owned lands, reservation lands, and ITAs in general will be further evaluated at the project level when site-specific project locations are determined.

The proposed program would not affect water rights or hunting and fishing rights. Effects of the proposed program on water quality are addressed in Chapter 5, Water Quality, and were found to be less than significant with mitigation. Effects on fish are addressed in Chapter 11, Fisheries and Aquatics, and were found to be less than significant with mitigation with the exception of loss of fish habitat and spawning habitat, which remained significant and unavoidable under Alternative 2. Effects on common wildlife are addressed in Chapter 12, Wildlife, and were found to be less than significant with mitigation. While effects on special-status wildlife were found to be significant and unavoidable under Alternatives 2, 4, 5, and 6, these species are not legally hunted. Overall, proposed program effects to ITAs are expected to be less than significant. The nearest known Tribal fishing rights are those of the Hoopa Valley Tribe on the Trinity River, which is not within the program area and would not be affected by the proposed program.

Chapter 24
Compliance with Applicable Laws, Policies, Plans, and Regulatory Framework

Introduction

This chapter provides preliminary information on the major requirements for permitting and environmental review and consultation for implementation of the Sacramento River Bank Protection Project (SRBPP) Phase II Supplemental Authority (proposed program). Certain local, state, and federal regulations require issuance of permits before proposed program implementation; other regulations require agency consultation but may not require issuance of any authorization or entitlements before proposed program implementation.

Regulatory Framework

Federal Requirements

National Environmental Policy Act

The National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 et seq., applies to all federal agencies and most of the activities they manage, regulate, or fund that have the potential to affect the environment. It requires federal agencies to disclose and consider the environmental implications of their proposed actions. NEPA establishes environmental policies for the nation, provides an interdisciplinary framework for federal agencies to prevent environmental damage, and contains action-forcing procedures to ensure that federal agency decision makers take environmental factors into account.

NEPA requires the preparation of an appropriate document to ensure that federal agencies accomplish the law's purposes. The President's Council on Environmental Quality (CEQ) has adopted regulations and other guidance that provide detailed procedures that federal agencies must follow to implement NEPA.

This document is the instrument for NEPA compliance for the proposed program under the Corps' authority, as described in Chapter 1, Introduction.

Federal Endangered Species Act

Section 7 of the Endangered Species Act (ESA), 16 U.S.C. § 1536, requires federal agencies, in consultation with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS), to ensure that their actions do not jeopardize the continued existence of endangered or threatened species, or result in the destruction or adverse modification of the critical habitat of these species. The required steps in the Section 7 consultation process are as follows.

- Agencies must request information from USFWS and/or NMFS on the existence in a project area of special-status species or species proposed for listing.
- Agencies must initiate formal consultation with USFWS and/or NMFS if the proposed action may adversely affect special-status species.

The proposed program may affect special-status species. The Corps will submit a Programmatic Biological Assessment and request issuance of a Programmatic Biological Opinion from USFWS and NMFS. As part of subsequent, project-level environmental analysis of future program activities, project proponents will work with agencies as part of the environmental compliance process to determine specific mitigation and compensation requirements for effects on endangered or threatened species, as well as critical habitat, under the terms of the anticipated Programmatic Biological Opinion.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA), 16 U.S.C. §§ 703-712, implements a series of international treaties that provide for migratory bird protection. The MBTA authorizes the Secretary of the Interior to regulate the taking of migratory birds; the act provides that it is unlawful, except as permitted by regulations, "to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird..." (16 U.S.C. § 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in direct loss of birds, nests, or eggs. The current list of species protected by the MBTA includes several hundred species and essentially includes all native birds. Permits for take of non-game migratory birds can be issued only for specific activities, such as scientific collecting, rehabilitation, propagation, education, taxidermy, and protection of human health and safety and personal property.

Compliance with the MBTA would be addressed through compliance with the ESA and CESA. The proposed program incorporates mitigation measures that would help ensure that construction activities do not result in the take of migratory birds, as discussed in Chapter 12, Wildlife.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act, 16 U.S.C. §§ 668-668c, provides for the protection of the bald eagle and the golden eagle by prohibiting, except under certain specified conditions, the take, possession, and commerce of such birds.

The program study area does not contain bald eagle or golden eagle nesting habitat, and the proposed program would not result in the take of bald or golden eagles. The proposed program incorporates mitigation measures that would ensure that construction activities do not result in the take of any raptors, as discussed in Chapter 12, Wildlife.

Clean Water Act Section 404, 404(b)(1) Guidelines, and Section 401

Section 404

Section 404 of the Clean Water Act (CWA), 33 U.S.C. § 1344, requires that a permit be obtained from the Corps for the discharge of dredged or fill material into "waters of the United States, including wetlands."

Waters of the United States include wetlands and lakes, rivers, streams, and their tributaries; they are defined for regulatory purposes, at 33 C.F.R. § 328.3(a) as:

> (1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of tide; (2) All interstate waters, including interstate wetlands; (3) All other waters such as intrastate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce; (4) All impoundments of waters otherwise defined as waters of the United States under the definition; (5) Tributaries of waters identified in paragraphs 1–4 in this section; (6) The territorial seas; and (7) Wetlands adjacent to waters identified in paragraphs 1–6 in this section.

Wetlands are defined as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR §328[e]). For an area to be considered a wetland, it must exhibit positive indicators of all three Federal wetland criteria (hydrophytic vegetation, hydric soils, and wetland hydrology).

CWA Section 404(b) requires that the Corps process permits in compliance with guidelines developed by EPA. These guidelines (404[b][1] Guidelines) in 40 CFR Part 230 require that there be an analysis of alternatives available to meet the project purpose and need, including those that avoid and minimize discharges of dredged or fill materials in waters. Once this first test has been satisfied, the project that is permitted must be the least environmentally damaging practicable alternative.

To the extent that the Corps undertakes erosion site repairs under the proposed program, no permit would be issued, but the substantive requirements of Section 404 will be met as necessary through NEPA compliance.

Section 401

Under the CWA Section 401, 33 U.S.C. § 1341, applicants for a federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that may affect state water quality and that require federal agency approval (such as issuance of a Section 404 permit) must also comply with CWA Section 401. In California, the authority to grant water quality certification has been delegated to the State Water Board, and applications for water quality certification under CWA Section 401 are typically processed by the RWQCB with local jurisdiction. Water quality certification requires evaluation of potential impacts in light of water quality standards and CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United States.

As the proposed program constitutes a federal action that may affect state water quality, a request for certification under CWA Section 401 will be submitted.

River and Harbors Appropriation Act of 1899

The River and Harbors Appropriation Act of 1899 addresses activities that involve the construction of dams, bridges, dikes, and other structures across any navigable water, or that place obstructions to navigation outside established federal lines and excavate from or deposit material in such waters. Such activities require permits from the Corps. "Navigable waters" are defined in 33 C.F.R. § 329.4 as:

> [T]hose waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the water body, and is not extinguished by later actions or events which impede or destroy navigable capacity.

Section 9

Section 9 (33 U.S.C. § 401) prohibits the construction of any bridge, dam, dike, or causeway across any navigable water of the United States in the absence of congressional consent and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the water body lie wholly within the limits of a single state, the structure may be built under authority of the legislature of that state, if the location and plans or any modification thereof are approved by the Chief of Engineers and by the Secretary of the Army.

Section 10

Section 10 (33 U.S.C. § 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section provides that the construction of any structure in or over any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters, is unlawful unless the work has been authorized by the Chief of Engineers.

Section 13

Section 13 (33 U.S.C. § 407) provides that the Secretary of the Army, whenever the Chief of Engineers determines that anchorage and navigation would not be injured thereby, may permit the discharge of refuse into navigable waters. In the absence of a permit, such discharge of refuse is prohibited. While the prohibition of this section, known as the Refuse Act, is still in effect, the permit authority of the Secretary of the Army has been superseded by the permit authority provided the Administrator, EPA, and the states under Sections 402 and 405 of the CWA, respectively.

As described above in the Clean Water Act discussion, the proposed program would not affect waters of the United States under Section 404 or navigable waters under the Rivers and Harbors Appropriation Act of 1899.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), 16 U.S.C. §§ 1801-1883, establishes a management system for national marine and estuarine fishery resources. In 1996, Congress passed the Sustainable Fisheries Act to amend the Magnuson-Stevens Act and require that all federal agencies consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect essential fish habitat (EFH). EFH is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The legislation states that migratory routes to and from anadromous fish spawning grounds are considered EFH. The phrase *adversely affect* refers to the creation of any effect that reduces the quality or quantity of essential fish habitat. Federal activities that occur outside of an essential fish habitat but that may, nonetheless, have an impact on essential fish habitat waters and substrate must also be considered in the consultation process.

Under the Magnuson-Stevens Act, effects on habitat managed under the Pacific Salmon Fishery Management Plan must also be considered. The Magnuson-Stevens Act states that consultation regarding essential fish habitat should be consolidated, where appropriate, with the interagency consultation, coordination, and environmental review procedures required by other federal statutes, such as NEPA, Fish and Wildlife Coordination Act, CWA, and ESA. EFH consultation requirements can be satisfied through concurrent environmental compliance if the lead agency provides NMFS with timely notification of actions that may adversely affect EFH and if the notification meets requirements for essential fish habitat assessments.

The entire program area is designated as EFH by the Pacific Fishery Management Council. The Corps has prepared a Biological Assessment to be submitted to USFWS and NMFS pursuant to obtaining a Biological Opinion. The consultation process will include consideration of and compliance with the Magnuson-Stevens Act to determine effects on EFH.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661-666c, in general requires federal agencies to coordinate with USFWS and state fish and game agencies whenever streams or bodies of water are controlled or modified. This coordination is intended both to promote the conservation of wildlife resources by providing equal consideration for fish and wildlife in water project planning and to provide for the development and improvement of wildlife resources in connection with water projects. Federal agencies undertaking water projects are required to include recommendations made by USFWS and state fish and game agencies in project reports, and give full consideration to these recommendations.

The Corps has initiated coordination with USFWS under the Fish and Wildlife Coordination Act and the draft Coordination Act Report for the proposed program was issued in October 2012 (Appendix I).

Farmland Protection Policy Act and Memoranda on Farmland Preservation

The Farmland Protection Policy Act (FPPA) (7 USC Section 4201, et seq.) and the CEQ policy Memoranda on Farmland Preservation dated August 11, 1980 require federal agencies to include assessments of the potential effects of a proposed project on prime and unique farmland. Federal agencies must determine these effects before taking any action that could result in converting designated prime or unique farmland for nonagricultural purposes. If implementing a project would adversely affect farmland preservation, the agencies must consider alternative actions to lessen those effects. Federal agencies also must ensure that their programs, to the extent feasible, are compatible with state, local, and private programs to protect farmland. NRCS is the federal agency responsible for ensuring that these laws and policies are followed.

Although it cannot be known at this time whether the proposed program would result in the conversion of prime or unique farmland to accommodate certain bank protection measures, additional project-level environmental documentation, tiering from this programmatic analysis, would be conducted to address erosion sites that will be constructed.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA), 16 U.S.C. § 470f, requires federal agencies to evaluate the effects of their undertakings on historic properties, which are those properties listed or eligible for listing on the National Register of Historic Places. Implementing regulations at 36 C.F.R. Part 800 require that federal agencies, in consultation with State Historic Preservation Officer (SHPO), identify historic properties within the Area of Potential Effect (APE) of the proposed project and make an assessment of adverse effects if any are identified. If the project is determined to have an adverse effect on historic properties, the federal agency is required to consult further with SHPO and the Advisory Council on Historic Preservation (ACHP) to develop methods to resolve the adverse effects. The Section 106 process has five basic steps.

1. Initiate the Section 106 process, including the identification of consulting parties, such as Native American tribes.
2. Identify and evaluate cultural resources to determine whether they are historic properties.
3. Assess the effects of the undertaking on historic properties within the APE.
4. If historic properties may be subject to an adverse effect, the federal agency, the SHPO, and any other consulting parties (including Native American tribes and the ACHP) continue consultation to seek ways to avoid, minimize, or mitigate the adverse effect. An Memorandum of Agreement (MOA) is usually developed to document the measures agreed upon to resolve adverse effects. Alternatively, the federal agency may prepare and execute a Programmatic Agreement (PA) with the aforementioned parties to comply with 36 C.F.R. Part 800, particularly in the context of complex undertakings that entail years of implementation actions or where the undertaking's effects on historic properties cannot be well characterized during the planning phase.
5. Proceed in accordance with the terms of the MOA or PA.

The efforts taken to identify cultural resources within the APE and any potential effects are discussed in Chapter 19, Cultural Resources. The Corps and DWR have determined that developing a PA for the proposed program and an attending Historic Properties Treatment Plan (HPTP) is the most effective way to accommodate program requirements with compliance with NEPA, Section 106 of the NHPA, and CEQA. The Corps has initiated consultation with tribes with potential interest in the program area. Consultation included requesting comments on the PA and HPTP, additional outreach meetings with individual tribes, and finally requesting their participation as concurring parties to the PA. To date, the California Valley Miwok Tribe, Mechoopda Indian Tribe of Chico Rancheria, and the Shingle Springs Band of Miwok have signed as concurring parties. Those tribes that have not signed as concurring parties to the PA will still be given an opportunity to comment on specific construction projects as they are designed and planned. The Cultural Resource PA is provided in Appendix B.

American Indian Religious Freedom Act

The American Indian Religious Freedom Act of 1978, Pub. L. No. 95-431, 92 Stat. 469 (1978), codified at 42 U.S.C. § 1996, is also applicable to federal undertakings. This act established "the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites."

It is not anticipated that actions related to the proposed program will conflict with the American Indian Religious Freedom Act. As discussed previously, and in Chapter 19, Cultural Resources, the Corps and DWR have consulted with the Native American Heritage Commission and the Sacred Lands database was negative for findings in the project areas.

Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act (16 U.S.C. § 1271 *et seq*.) establishes a National Wild and Scenic Rivers System for the protection of rivers with important scenic, recreational, fish and wildlife, and other values. Rivers are classified as wild, scenic, or recreational. The act designates specific rivers for inclusion in the System and prescribes the methods and standards by which additional rivers may be added. The lower American River, from the Nimbus dam to its confluence with the Sacramento River, is included in the system and is designated as Recreational. Any erosion sites located along the lower American River would be subject to the conditions of this act. The National Parks Service, working under the United States Department of the Interior, has the jurisdiction for determination of whether any violations occur.

Executive Order 11988 (Floodplain Management)

Executive Order 11988 (May 24, 1977) requires federal agencies to prepare floodplain assessments for proposed actions located in or affecting floodplains. If an agency proposes to conduct an action in a floodplain, it must to the degree possible avoid short and long term adverse effects associated with the occupancy and the modification of a floodplain and to avoid direct and indirect support of floodplain development whenever there is a reasonable and feasible alternative. If the only reasonable and feasible alternative involves siting in a floodplain, the agency must minimize potential harm to or in the floodplain and explain why the action is proposed in the floodplain.

The program proposes to improve existing flood protection facilities and would not directly or indirectly propose floodplain development. Please see further discussion in Chapter 22, Growth-Inducing Effects.

Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 (May 24, 1977) requires federal agencies to prepare wetland assessments for proposed actions located in or affecting wetlands. Agencies must avoid undertaking new construction in wetlands unless no practicable alternative is available and the proposed action includes all practicable measures to minimize harm to wetlands. Chapter 10, Vegetation and Wetlands, describes effects on wetlands and mitigation measures for reducing significant effects of the proposed program.

Executive Order 12898 (Environmental Justice)

Executive Order 12898 (February 11, 1994) requires federal agencies to identify and address adverse human health or environmental effects of federal programs, policies, and activities that could be disproportionately high on minority and low-income populations. Federal agencies must ensure that federal programs or activities do not directly or indirectly result in discrimination on the basis of race, color, or national origin. Federal agencies must provide opportunities for input into the NEPA process by affected communities and must evaluate the potentially significant and adverse environmental effects of proposed actions on minority and low-income communities during environmental document preparation. Even if a proposed federal project would not result in significant adverse impacts on minority and low-income populations, the environmental document must describe how Executive Order 12898 was addressed during the NEPA process.

Environmental justice issues are discussed in Chapter 20, Socioeconomics and Environmental Justice. In summary, the proposed program would not result in any significant effects on minority or low-income populations. In reality, the proposed program would increase flood protection to nearby established diverse communities of mixed income and ethnicity.

Executive Order 13007 (Indian Sacred Sites) and April 29, 1994, Executive Memorandum

Executive Order 13007 (May 24, 1996) requires federal agencies with land management responsibilities to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites. Among other things, federal agencies must provide reasonable notice of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. The agencies must comply with the April 29, 1994, Executive Memorandum, *Government-to-Government Relations with Native American Tribal Governments*.

Based on consultation with NAHC and the Sacred Lands Database, four sacred properties were identified in the vicinity of the program area. Information about the development of the PA and HPTP are described above under the National Historic Preservation Act section.

Federal Clean Air Act

The federal Clean Air Act (CAA), 42 U.S.C. § 7401 et seq., was enacted to protect and enhance the nation's air quality in order to promote public health and welfare and the productive capacity of the nation's population. The CAA requires an evaluation of any federal action to determine its potential impact on air quality in the project region. California has a corresponding law, which also must be considered during the EIR process.

For specific projects, federal agencies must coordinate with the appropriate air quality management district as well as with EPA. This coordination would determine whether the project conforms to the CAA and the State Implementation Plan (SIP).

Section 176 of the CAA, 42 U.S.C. § 7506, prohibits federal agencies from engaging in or supporting in any way an action or activity that does not conform to an applicable SIP. Actions and activities must conform to a SIP's purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and in attaining those standards expeditiously. EPA promulgated conformity regulations (codified in 40 C.F.R. § 93.150 *et seq.*).

The potential air quality impacts of the proposed program resulting from construction (such as equipment emissions and fugitive dust) are discussed in Chapter 8, Air Quality and Climate Change, which analyzes and documents compliance with the CAA.

Federal Water Project Recreation Act

The federal Water Project Recreation Act, 16 U.S.C. §§ 460(L)(12) – 460(L)(21), requires federal agencies with authority to approve water projects to include recreation development as a condition of approving permits. Recreation development must be considered along with any navigation, flood control, reclamation, hydroelectric, or multi-purpose water resource project. The act states that, "[c]onsideration should be given to opportunities for outdoor recreation and fish and wildlife enhancement whenever any such project can reasonably serve either or both purposes consistently."

Recreation effects, such as temporary loss to river access, are described in Chapter 14, Recreation.

Resource Conservation and Recovery Act

The federal Resource Conservation and Recovery Act enables EPA to administer a regulatory program that extends from the manufacture of hazardous materials to their disposal, thus regulating the generation, transportation, treatment, storage, and disposal of hazardous waste at all facilities and sites in the nation.

No materials classified as hazardous are proposed to be used for the proposed program.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9601 et seq., (also known as Superfund) was passed to facilitate the cleanup of the nation's toxic waste sites. In 1986, the act was amended by the Superfund Amendment and Reauthorization Act Title III, Pub. L. No. 99-499, 100 Stat. 1613 (1986) (community right-to-know laws). Title III states that past and present owners of land contaminated with hazardous substances can be held liable for the entire cost of the cleanup, even if the material was dumped illegally when the property was under different ownership.

Effects related to hazardous waste sites are discussed in Chapter 18, Public Health and Environmental Hazards.

Wildlife Hazards on or Near Airports

The Federal Aviation Administration addresses control of hazardous wildlife in Advisory Circular 150/5200-33B, *Hazardous Wildlife Attractants on or near Airports*. The Federal Aviation Administration provides direction on where public-use airports should restrict land uses that have the potential to attract hazardous wildlife. The Federal Aviation Administration recommends a distance of 10,000 feet separating wildlife attractants and aircraft movement areas. The area within a 10,000-foot radius of the Airport Operations Area is designated as the Critical Zone. The definition of wildlife attractants in Advisory Circular 150/5200-33A includes human-made or natural areas, such as poorly drained areas, retention ponds, agricultural activities, and wetlands. Advisory Circular 150/5200-33A recommends against the use of airport property for agricultural production within a 5-mile radius of the Airport Operations Area unless the income from the agricultural crops is necessary for the economic viability of the airport.

Effects related to wildlife hazards are described in Chapter 18, Public Health and Environmental Hazards.

Uniform Relocation Assistance and Real Property Acquisition Policies Act

Federal, state, local government agencies, and others receiving federal financial assistance for public programs and projects that require the acquisition of real property must comply with the policies and provisions set forth in the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. § 4601 *et seq.*) (Uniform Act), and implementing regulations, 49 C.F.R. Part 24. Relocation advisory services, moving costs reimbursement, replacement housing, and reimbursement for related expenses and rights of appeal are provided for in the Uniform Act.

While all or portions of parcels within the SRBPP footprints may need to be acquired to construct certain bank protection measures, it is not anticipated that the proposed program will require construction of new housing However, if necessary, property acquisition and relocation services, compensation for living expenses for temporarily relocated residents, and negotiations regarding any compensation for temporary loss of business would be accomplished in accordance with the Uniform Act and California Government Code Section 7267 *et seq*.

State Requirements

California Environmental Quality Act

CEQA requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The environmental review required imposes both procedural and substantive requirements. At a minimum, an initial review of the project and its environmental effects must be conducted. CEQA's primary objectives are to:

- disclose to decision makers and the public the significant environmental effects of proposed activities,
- identify ways to avoid or reduce environmental damage,
- prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures,
- disclose to the public reasons for agency approval of projects with significant environmental effects,
- foster interagency coordination in the review of projects, and
- enhance public participation in the planning process.

CEQA applies to all discretionary activities proposed to be carried out or approved by California public agencies, including state, regional, county, and local agencies, unless an exemption applies. The act requires that public agencies comply with both procedural and substantive requirements. Procedural requirements include the preparation of the appropriate public notices (including notices of preparation), scoping documents, alternatives, environmental documents (including mitigation measures, mitigation monitoring plans, responses to comments, findings, and statements of overriding considerations), completion of agency consultation and State Clearinghouse review, and provisions for legal enforcement and citizen access to the courts.

CEQA's substantive provisions require agencies to address environmental impacts disclosed in an appropriate document. When avoiding or minimizing environmental damage is not feasible, CEQA requires agencies to prepare a written statement of overriding considerations when they decide to approve a project that will cause one or more significant effects on the environment that cannot be mitigated. CEQA establishes a series of action-forcing procedures to ensure that agencies accomplish the purposes of the law. In addition, under the direction of CEQA, the California Resources Agency has adopted regulations, known as the State CEQA Guidelines, which provide detailed procedures that agencies must follow to implement the law.

This document is the instrument for CEQA compliance for the proposed program under the Corps' authority, as described in Chapter 1.

California Endangered Species Act

CESA is similar to ESA but pertains only to state-listed endangered and threatened species. CESA requires state agencies to consult with the California Department of Fish and Wildlife (DFW) when preparing documents under CEQA to ensure that the actions of the state lead agency do not jeopardize the continued existence of listed species. CESA directs agencies to consult with DFW on projects or actions that could affect listed species, directs DFW to determine whether there would be jeopardy to listed species, and allows DFW to identify "reasonable and prudent alternatives" to the project consistent with conserving the species. Agencies can approve a project that affects a listed species if the agency determines that there are "overriding considerations;" however, the agencies are prohibited from approving projects that would cause the extinction of a listed species.

Mitigating impacts on state-listed species involves avoidance, minimization, and compensation (listed in order of preference). Unavoidable impacts on state-listed species are typically addressed in a detailed mitigation plan prepared in accordance with DFW guidelines. DFW exercises authority over mitigation projects involving state-listed species, including those resulting from CEQA mitigation requirements.

CESA prohibits the "take" of plant and wildlife species state-listed as endangered or threatened. DFW may authorize take if there is an approved habitat management plan or management agreement that avoids or compensates for impacts on listed species.

Effects on wildlife resources are discussed in Chapter 12, Wildlife.

Porter-Cologne Water Quality Control Act of 1969

In 1967, the Porter-Cologne Act established the State Water Board and nine RWQCBs as the primary state agencies with regulatory authority over California water quality and appropriative surface water rights allocations. Under this act (and the CWA), the state is required to adopt a water quality control policy and WDRs to be implemented by the State Water Board and nine RWQCBs. The State Water Board also establishes Basin Plans and statewide plans. The RWQCBs carry out State Water Board policies and procedures throughout the state.

Basin Plans designate beneficial uses for specific surface water and groundwater resources and establish water quality objectives to protect those uses. The project has the potential to affect water quality in surface water or groundwater within the project area which is governed by the Central Valley RWQCB.

Chapter 5, Water Quality and Groundwater Resources, describes water quality effects and mitigation measures for the proposed program.

Central Valley Flood Protection Board Encroachment Permit

The CVFPB (formerly The Reclamation Board) requires an encroachment permit for any non-federal activity along or near federal flood damage reduction project levees and floodways or in CVFPB-designated floodways to ensure that proposed local actions or projects do not impair the integrity of existing flood damage reduction systems to withstand flood conditions. The proposed program does not require an encroachment permit, as it is a federal activity and the CVFPB is the CEQA lead agency. The proposed program will go before the CVFPB for consideration under CEQA.

California Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act of 1975 (PRC Section 2710 *et seq*.) (SMARA) addresses surface mining. Activities subject to SMARA include, but are not limited to, mining of minerals, gravel, and borrow material. The SMARA statute requires mitigation to reduce adverse impacts on public health, property, and the environment. Because SAFCA would require borrow material for project construction, SAFCA must comply with SMARA. SMARA applies to an individual or entity that would disturb more than 1 acre or remove more than 1,000 cubic yards of material through surface mining activities, including the excavation of borrow pits for soil material. SMARA is implemented through ordinances for permitting developed by local government lead agencies that provide the regulatory framework under which local mining and reclamation activities are conducted. The State Mining and Geology Board reviews the local ordinances to ensure that they meet the procedures established by SMARA.

The Corps is not subject to SMARA requirements and therefore this regulation is not applicable to activities carried out as part of the proposed program.

California Important Farmland Inventory System and Farmland Mapping and Monitoring Program

The California Department of Conservation, Office of Land Conservation, maintains a statewide inventory of farmlands. These lands are mapped by the Division of Land Resource Protection as part of the Farmland Mapping and Monitoring Program. The maps are updated every 2 years with the use of aerial photographs, a computer mapping system, public review, and field reconnaissance. Farmlands are divided into the following five categories based on their suitability for agriculture.

- Prime Farmland: land that has the best combination of physical and chemical characteristics for crop production. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when treated and managed.
- Farmland of Statewide Importance: land other than Prime Farmland that has a good combination of physical and chemical characteristics for crop production.
- Unique Farmland: land that does not meet the criteria for Prime Farmland or Farmland of Statewide Importance, but that has been used for the production of specific crops with high economic value.
- Farmland of Local Importance: land that is either currently producing crops or has the capability of production, but that does not meet the criteria of the categories above.
- Grazing Land: land on which the vegetation is suited to the grazing of livestock.

These categories are sometimes referred to as Important Farmland. Other categories used in the mapping system are urban and built-up lands, lands committed to nonagricultural use, and other lands (land that does not meet the criteria of any of the other categories).

Effects on Prime Farmland and Farmland of Statewide Importance within the program area are addressed in Chapter 13, Land Use and Agriculture.

California Land Conservation Act (Williamson Act)

The California Land Conservation Act of 1965, commonly known as the Williamson Act (California Government Code Section 51200 *et seq*.), enables local governments to enter into contracts with private landowners for the purpose of promoting the continued use of the relevant land in agricultural or related open space use. In return, landowners receive property tax assessments that are based on farming and open space uses instead of full market value. Local governments receive an annual subvention (subsidy) of forgone property tax revenues from the state via the Open Space Subvention Act of 1971.

The Williamson Act empowers local governments to establish agricultural preserves consisting of lands devoted to agricultural uses and other compatible uses. Upon establishment of such preserves, the locality may offer to owners of included agricultural land the opportunity to enter into annually renewable contracts that restrict the land to agricultural use for at least 10 years (i.e., the contract continues to run for 10 years following the first date upon which the contract is not renewed). In return, the landowner is guaranteed a relatively stable tax rate, based on the value of the land for agricultural/open space use only and unaffected by its development potential.

As a public agency that may acquire lands within agricultural preserves, including lands under contract, SAFCA is exempt from the normal cancellation process for Williamson Act contracts, because the contract is nullified for the portion of the land actually acquired (California Government Code Section 51295). SAFCA must provide notice to the California Department of Conservation prior to acquiring such lands (California Government Code Section 51291[b]). A second notice is required within 10 working days after the land is actually acquired (California Government Code Section 51291 (c J). As the land would be acquired for flood damage reduction measures, SAFCA is exempt from the findings required in California Government Code Section 51292 (California Government Code Section 51293[e][1]) because the proposed project consists of flood control works. The preliminary notice to the California Department of Conservation, provided before lands are actually acquired, would demonstrate the purpose of the project and the exemption from the findings.

Williamson Act contracts are not relevant to the proposed program because Williamson Act contracts are deemed null and void when Williamson Act land is acquired in lieu of eminent domain for a public improvement by a public agency.

California Fish and Game Code Section 3503 and 3503.5—Protection of Bird Nests and Raptors

Section 3503 of the California Fish and Game Code states that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird. Section 3503.5 specifically states that it is unlawful to take, possess, or destroy any raptors (i.e., species in the orders *Falconiformes* and *Strigiformes*), including their nests or eggs. Typical violations of these codes include destruction of active nests resulting from removal of vegetation in which the nests are located. Violation of Section 3503.5 could also include failure of active raptor nests resulting from disturbance of nesting pairs by nearby project construction. This statute does not provide for the issuance of any type of incidental take permit.

California Fish and Game Code—Fully Protected Species

Protection of fully protected species is described in Sections 3511, 4700, 5050, and 5515 of the California Fish and Game Code. These statutes prohibit take or possession of fully protected species and do not provide for authorization of incidental take of fully protected species. DFW has informed non-federal agencies and private parties that their actions must avoid take of any fully protected species.

Basin Plan

Pursuant to the Porter-Cologne Act, the Central Valley RWQCB prepares and updates the Basin Plan for the Sacramento and San Joaquin River Basins every 3 years; the most recent update was completed in February 2007 (Central Valley Regional Water Quality Control Board 2007). The Basin Plan describes the officially designated beneficial uses for specific surface water and groundwater resources and the enforceable water quality objectives necessary to protect those beneficial uses. The Natomas Basin is located within the Central Valley RWQCB jurisdiction and is subject to the Basin Plan.

The Basin Plan includes numerical and narrative water quality objectives for physical and chemical water quality constituents. Numerical objectives are set for temperature, DO, turbidity, and pH; TDS, electrical conductivity, bacterial content, and various specific ions; trace metals; and synthetic organic compounds. Narrative objectives are set for parameters such as suspended solids, biostimulatory substances (e.g., nitrogen and phosphorus), oil and grease, color, taste, odor, and aquatic toxicity. Narrative objectives are often precursors to numeric objectives. The primary method used by the Central Valley RWQCB to ensure conformance with the Basin Plan's water quality objectives and implementation policies and procedures is to issue WDRs for projects that may discharge wastes to land or water. WDRs specify terms and conditions that must be followed during the implementation and operation of a project.

California Toxics Rule and State Implementation Policy

The CTR was promulgated in 2000 in response to requirements of the EPA NTR. The NTR and CTR criteria are regulatory criteria adopted for inland surface waters, enclosed bays, and estuaries in California that are subject to regulation pursuant to Section 303(c) of the CWA. The NTR and CTR include criteria for the protection of aquatic life and human health. Human health criteria (water and organisms) apply to all waters with a Municipal and Domestic Supply beneficial use designation as indicated in the RWQCBs' basin plans. The Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California, also known as the State Implementation Plan, was adopted by the State Water Board in 2000 to establish provisions for translating CTR criteria, NTR criteria, and basin plan water quality objectives for toxic pollutants into the following:

- NPDES permit effluent limits,
- compliance determinations,
- monitoring for dioxin (2,3,7,8-TCDD) equivalents,

- chronic toxicity control provisions,
- initiating site-specific objective development, and
- granting exceptions.

See Chapter 5, Water Quality and Groundwater Resources, for information related to the proposed program and the CTR.

California Register of Historic Resources

The CRHR includes resources that are listed in or formally determined eligible for listing in the NRHP (see Chapter 19, Cultural Resources) as well as some California State Landmarks and Points of Historical Interest (PRC Section 5024.1, 14, CCR Section 4850). Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts) or that have been identified in a local historical resources inventory may be eligible for listing in the CRHR and are presumed to be significant resources for purposes of CEQA unless a preponderance of evidence indicates otherwise (State CEQA Guidelines Section 15064.5[a][2]). The eligibility criteria for listing in the CRHR are similar to those for NRHP listing but focus on the importance of the resources to California history and heritage. A cultural resource may be eligible for listing in the CRHR if it:

1. is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
2. is associated with the lives of person important in our past;
3. embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important individual, or possesses high artistic values; or
4. has yielded, or may be likely to yield, information important in prehistory or history.

Native American Heritage Commission

NAHC identifies and catalogs places of special religious or social significance to Native Americans and known graves and cemeteries of Native Americans on private lands, and performs other duties regarding the preservation and accessibility of sacred sites and burials and the disposition of Native American human remains and burial items. Consultation with NAHC, the Sacred Lands database, and Native American groups are discussed above under the National Historic Preservation Act section and also in Chapter 19 of this document, Cultural Resources.

California Climate Solutions Act

In September 2006, Governor Arnold Schwarzenegger signed AB 32, the California Climate Solutions Act of 2006. AB 32 requires that statewide GHG emissions be reduced to 1990 levels by 2020. This reduction will be accomplished through an enforceable statewide cap on GHG emissions that will be phased in starting in 2012. To effectively implement the cap, AB 32 directs CARB to develop and implement regulations to reduce statewide GHG emissions from stationary sources. AB 32 specifies that regulations adopted in response to AB 1493 should be used to address GHG emissions from vehicles. However, AB 32 also includes language stating that if the AB 1493 regulations cannot be implemented, then CARB should develop new regulations to control vehicle GHG emissions under the authorization of AB 32.

AB 32 requires that CARB adopt a quantified cap on GHG emissions representing 1990 emissions levels and disclose how it arrives at the cap; institute a schedule to meet the emissions cap; and develop tracking, reporting, and enforcement mechanisms to ensure that the state achieves the reductions in GHG emissions necessary to meet the cap. AB 32 also includes guidance to institute emissions reductions in an economically efficient manner and conditions to ensure that businesses and consumers are not unfairly affected by the reductions.

Contributions of GHG emissions related to the proposed program are discussed in Chapter 8, Air Quality and Climate Change.

State of California General Plan Guidelines

The OPR published the *State of California General Plan Guidelines* (Governor's Office of Planning and Research 2003), which provides guidance for the acceptability of projects within specific L_{dn} contours. Generally, residential uses (e.g., mobile homes) are considered to be acceptable in areas where exterior noise levels do not exceed 60 dBA L_{dn}. Residential uses are normally unacceptable in areas exceeding 70 dBA L_{dn} and conditionally acceptable within 55–70 dBA L_{dn}.

Schools are normally acceptable in areas up to 70 dBA L_{dn} and normally unacceptable in areas exceeding 70 dBA L_{dn}. Commercial uses are normally acceptable in areas with a CNEL of up to 70 dBA. Commercial uses are conditionally acceptable where the L_{dn} is between 67.5 and 77.5 dBA, depending on the noise insulation features and the noise reduction requirements. The guidelines also provide adjustment factors for determining noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

Noise studies and project-related impacts and mitigation are discussed in Chapter 9, Noise.

California Code of Regulations, Title 24

Title 24 of CCR establishes standards governing interior noise levels that apply to all new multi-family residential units in California. These standards require that acoustical studies be performed before construction begins at locations where the existing L_{dn} exceeds 60 dBA. Such acoustical studies are required to establish mitigation measures that limit maximum L_{dn} levels to 45 dBA in any habitable room. Although no generally applicable interior noise standards are pertinent to all uses, many communities in California have adopted an L_{dn} of 45 dBA as an upper limit on interior noise in all residential units.

Noise studies are discussed in Chapter 9, Noise.

Central Valley Flood Control Act of 2008

The Central Valley Flood Control Act of 2008, passed in 2007, recognizes that the Central Valley of California is experiencing unprecedented development, resulting in the conversion of historically agricultural lands and communities to densely populated residential and urban centers. Because of the potentially catastrophic consequences of flooding, the Act recognizes that the federal government's current 100-year flood protection standard is not sufficient to protect urban and urbanizing areas within flood-prone areas throughout the Central Valley and declares that the minimum standard for these areas is a 200-year level of flood protection. To continue with urban development, cities and counties must develop and implement plans for achieving this new standard by 2025. The CVFPB adopted the CVFPP, a comprehensive new framework for systemwide flood management and flood risk reduction in the Sacramento and Joaquin River Basins, in June 2012. DWR is leading the planning and coordination of major implementation actions of the 2012 CVFPP, including State-led basin-wide feasibility studies, locally-led regional flood management planning, and the Central Valley Flood System Conservation Strategy. Each of these planning efforts will be incorporated into the next update of the CVFPP, which is scheduled for release in 2017. Implementation of CVFPP actions have already begun and will be expanded after the 2017 Plan is updated.

California Regulations for Environmental Justice

Most state governments have plans and policies intended to protect and expand the local and regional economies affecting the communities within their jurisdictions. State plans and policies also frequently address other social and economic impact topics, including fiscal conditions and related public services that affect local residents' quality of life.

Within California, SB 115 (Chapter 690, Statutes of 1999) was signed into law in 1999. The legislation established OPR as the coordinating agency for state environmental justice programs (California Government Code, Section 65040.12[a]) and defined environmental justice in statute as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" (Government Code Section 65040.12(e). SB 115 further required the CalEPA to develop a model environmental justice mission statement for boards, departments, and offices within the agency by January 1, 2001 (Public Resources Code, Sections 72000–72001).

In 2000, SB 89 (Chapter 728, Statutes of 2000) was signed, which complemented SB 115 by requiring the creation of an environmental justice working group and an advisory group to assist CalEPA in developing an intra-agency environmental justice strategy (PRC Sections 72002–72003). SB 828 (Chapter 765, Statutes of 2001) added and modified due dates for the development of CalEPA's intra-agency environmental justice strategy and required each board, department, and office within CalEPA to identify and address, no later than January 1,2004, any gaps in its existing programs, policies, and activities that may impede environmental justice (PRC, Sections 71114–71115).

Cal/EPA adopted its environmental justice policy in 2004 (California PRC, Sections 71110–71113). This policy (or strategy) provides guidance to its resource boards, departments, and offices. It is intended to help achieve the state's goal of "achieving fair treatment of people of all races, cultures and incomes with respect to the development, adoption, implementation and enforcement of environmental laws and policies."

AB 1553 (Chapter 762, Statutes of 2001) required OPR to incorporate environmental justice considerations in the General Plan Guidelines. AB 1553 specified that the guidelines should propose methods for local governments to address the following:

- planning for the equitable distribution of new public facilities and services that increase and enhance community quality of life,
- providing for the location of industrial facilities and uses that pose a significant hazard to human health and safety in a manner that seeks to avoid over-concentrating these uses in proximity to schools or residential dwellings,

- providing for the location of new schools and residential dwellings in a manner that avoids proximity to industrial facilities and uses that pose a significant hazard to human health and safety, and
- promoting more livable communities by expanding opportunities for transit-oriented development.

Although environmental justice is not a mandatory topic in the general plan, OPR is required to provide guidance to cities and counties for integrating environmental justice into their general plans. The 2003 edition of the *General Plan Guidelines* included the contents required by AB 1553 (see pages 8, 12, 20–27, 40, 114, 142, 144, and 260 of the revised *General Plan Guidelines*).

Environmental justice issues pertaining to the proposed program are discussed in Chapter 20, Socioeconomics and Environmental Justice.

Water Use Efficiency

The California Constitution prohibits the waste or unreasonable use of water. Further, Water Code Section 275 directs DWR and the State Water Board to “take all appropriate proceedings or actions before executive, legislative, or judicial agencies to prevent waste or unreasonable use of water.” Several legislative acts have been adopted to develop efficient use of water in the state:

- Urban Water Management Planning Act of 1985,
- Water Conservation in Landscaping Act of 1992,
- Agricultural Water Management Planning Act,
- Agricultural Water Suppliers Efficient Management Practices Act of 1990,
- Water Recycling Act of 1991, and
- Agricultural Water Conservation and Management Act of 1992.

The purpose of the proposed program is to address flood issues. The proposed program would not result in the waste or unreasonable use of water.

Public Trust Doctrine

When planning and allocating water resources, the State of California is required to consider the public trust and preserve for the public interest the uses protected by the trust. The public trust doctrine embodies the principle that certain resources, including water, belong to all and, thus, are held in trust by the state for future generations.

In common law, the public trust doctrine protects navigation, commerce, and fisheries uses in navigable waterways. However, the courts have expanded the doctrine’s application to include protecting tideland, wildlife, recreation, and other public trust resources in their natural state for recreational, ecological, and habitat purposes as they affect birds and marine life in navigable waters. *The National Audubon Society v. Superior Court of Alpine County* (1983) 33 Cal 3d 419 decision extended the public trust doctrine’s limitations on private rights to appropriative water rights, and also ruled that longstanding water rights could be subject to reconsideration and could possibly be curtailed. The doctrine, however, generally requires the court and the State Water Board to perform a balancing test to weigh the potential value to society of a proposed or existing diversion against its impact on trust resources.

The 1986 Rancanelli decision applied the public trust doctrine to decisions by the State Water Board and held that this doctrine must be applied by the State Water Board in balancing all the competing interests in the uses of Bay-Delta waters (*United States v. State Water Resources Control Board* [1986] 182 Cal. App. 3d 82).

The proposed program is consistent with the public trust doctrine, as the primary goal includes improved flood control.

Relocation Assistance and Property Acquisition

The State of California's Government Code Section 7260, *et seq.* brings the California Relocation Act into conformity with the federal Uniform Act. In the acquisition of real property by a public agency, both the federal and state acts seek to (1) ensure consistent and fair treatment of owners of real property, (2) encourage and expedite acquisition by agreement to avoid litigation and relieve congestion in the courts, and (3) promote confidence in public land acquisition.

The Relocation Assistance and Real Property Acquisition Guidelines were established by 25 CCR 1.6. The guidelines were developed to assist public entities with developing regulations and procedures implementing Title 42, Chapter 61 of the USC, the Uniform Act, for federal and federally assisted programs. The guidelines are designed to ensure that uniform, fair, and equitable treatment is given to people displaced from their homes, businesses, or farms as a result of the actions of a public entity. Under the act, persons required to relocate temporarily are not considered displaced, but must be treated fairly. Such persons have a right to temporary housing that is decent, safe, and sanitary, and must be reimbursed for all reasonable out-of-pocket expenses. In accordance with these guidelines, people may not suffer disproportionate injury as a result of action taken for the benefit of the public as a whole. Additionally, public entities must ensure consistent and fair treatment of owners of such property, and encourage and expedite acquisitions by agreement with owners of displaced property to avoid litigation.

If necessary, property acquisition and relocation services, compensation for living expenses for temporarily relocated residents, and negotiations regarding any compensation for temporary loss of business would be accomplished in accordance with the Uniform Act (see above) and California Government Code Section 7267 *et seq*.

State and Regional Plan Consistency

Clean Water Act, Section 303(d)

Under CWA Section 303(d), the RWQCB and the State Water Board list water bodies as impaired when not in compliance with designated water quality objectives and standards. A TMDL program must be prepared for waters identified by the state as impaired. A TMDL is a quantitative assessment of a problem that affects water quality. The problem can include the presence of a pollutant, such as a heavy metal or a pesticide, or a change in the physical property of the water, such as DO or temperature. A TMDL specifies the allowable load of pollutants from individual sources to ensure compliance with water quality standards. Once the allowable load and existing source loads have been determined, reductions in allowable loads are allocated to individual pollutant sources.

The proposed program would have no effect on TMDL issues for the Sacramento River.

Water Rights

The State of California recognizes riparian and appropriative surface water rights. Riparian rights are correlative entitlements to water that are held by owners of land bordering natural watercourses. California requires a statement of diversion and use of natural flows on adjacent riparian land under a riparian right. Appropriative water rights allow the diversion of a specified amount of water from a source for reasonable and beneficial use during all or a portion of the year. In California, previously issued appropriative water rights are superior to and take precedence over newly granted rights. The State Water Board has authority to issue permits to grant appropriative water rights. The proposed program is consistent with current water rights.

Local Plan Consistency and Regulatory Requirements

In addition to the federal and state regulatory and local plan requirements, the project may be subject to certain zoning or other ordinances and general plans of counties and cities within the program area. For more discussion on local plans and requirements applicable to the project, refer to Appendix C, Regulatory Background.

Chapter 25
List of Preparers

This EIS/EIR was prepared by ICF International at the direction of the U.S. Army Corps of Engineers. The following individuals participated in the preparation of this document.

U.S. Army Corps of Engineers

Name	Education/Experience	Contribution/Role
Lisa Clay	JD, 26 years' experience	Legal review/Attorney
Matthew Davis	MS, Biological Sciences 29 years' experience	NEPA document review/NEPA Regional Technical Specialist
Mike Dietl	BS, Fisheries 16 years' experience	Plan Formulation and Environmental Compliance
Miki Fujitsubo	Licensed Landscape Architect 24 years' experience	Water Resource Regional Technical Specialist
Brian Luke	BS, Biology 8 years' experience	Environmental Manager
Brian Mulvey	MS, Fisheries Science 24 years' experience	Environmental Lead/Fisheries Specialist
Nikki Polson	MA, Archaeology 15 years' experience	NHPA/Cultural Resources Specialist

California Department of Water Resources

Name	Education/Experience	Contribution/Role
Kip Young	BS, Animal Science 18 years' experience	CEQA lead and document review
Dave Wheeldon	BS, Environmental Engineering 19 years' experience	Project Manager

HDR Inc. Consulting

Name	Education/Experience	Contribution/Role
Thomas Adams	Masters in Landscape Architecture 32 years' experience	
Sergio Jimenez	Masters in Civil Engineering 13 years' experience	
Daniel Teak	BS in Civil Engineering 4 years' experience	

ICF International

Project Management

Name	Education/Experience	Contribution/Role
Gregg Ellis	BA, Geography 16 years' experience	Project Director
Sara Martin	BA, Anthropology 13 years' experience	Project Manager
Andrew Humphrey	BA, History 5 years' experience	Project Coordinator

Technical Staff

Name	Education/Experience	Contribution/Role
Jeff Peters	MS, Geography BA, Geology 15 years' experience	Geomorphology and Flood Control; Geology, Seismicity, Soils and Mineral Resources
Ken Casaday	MA, Geophysics BA, Geology and Geophysics 30+ years' experience	Geology, Seismicity, Soils and Mineral Resources, Senior Review
Lesa Erecius	MS, Pharmacology & Toxicology (Aquatic Toxicology focus) BS, Physiology 7 years' experience	Water Quality and Groundwater Resources
Russ Grimes	MS, Environmental Management BA, Environmental Studies 13 years' experience	Water Quality and Groundwater Resources, Senior Review
Nate Martin	MA, Public Administration BA, Environmental Studies (Biology minor) 13 years' experience	Water Quality and Groundwater Resources, Senior Review

Name	Education/Experience	Contribution/Role
Bonnie Chiu	BA, Political Science/Public Service 10 years' experience	Land Use and Agriculture
Andrew Humphrey	BA, History 5 years' experience	Transportation and Navigation; Public Health and Environmental Hazards; Socioeconomics and Environmental Justice
Kai-Ling Kuo	MS, Civil & Environmental Engineering BS, Civil Engineering 7 years' experience	Air Quality and Climate Change
Shannon Hatcher	BS, Environmental Science BS, Environmental Health and Safety 10+ years' experience	Air Quality and Climate Change, Senior Review
Jim Wilder	MS, Environmental Engineering BS, Civil Engineering 20+ years' experience	Noise
Jessica Hughes	MS, Botany and Plant Pathology BS, Biology 9 years' experience	Vegetation and Wetlands
Brad Schafer	BA, Biology 16 years' experience	Vegetation and Wetlands, Senior Review
Marin Greenwood	PhD, Fish Ecology MS, Applied Fish Biology BS, Aquatic Bioscience 10 years' experience	Fisheries and Aquatics
Donna Maniscalco	BS, Wildlife, Fish, and Conservation Biology 10 years' experience	Fisheries and Aquatics
Bill Mitchell	MS Fisheries Biology BA, Biology 25+ years' experience	Fisheries and Aquatics, Senior Review
Erin Hitchcock	BS, Wildlife, Fisheries, and Conservation Biology 9 years' experience	Wildlife
Stephanie Myers	MS Avian Sciences BA, Biology 20+ years' experience	Wildlife, Senior Review
Stefanie Lyster	MPA BA, Journalism 15 years' experience	Recreation
Julia Hooten	BA, Geography (Biology/Physical Environment concentration) 4 years' experience	Population and Housing; Utilities and Public Services
Jennifer Stock	BA, Landscape Architecture 12 years' experience	Visual Resources
Christiaan Havelaar	BA, Anthropology 11 years' experience	Cultural Resources

Name	Education/Experience	Contribution/Role
Dana McGowan	RPA MA, Anthropology BA, Anthropology 22 years' experience	Cultural Resources, Senior Review
Paul Shigley	BA, Government Journalism 26 years' experience	Lead Production Editor
Ken Cherry	BA, English 24 years' experience	Support Editor
Stephanie Monzon	MA, English BA, English Professional Certificate in Editing 9 years' experience	Support Editor
Deborah Jew	CA, Graphic Communication AA, General Education 26 years' experience	Publication Specialist
Senh Saelee	BS, Visual Communications Design 13 years' experience	Graphic Artist
Dan Moreno	MA, Geography BA, Geography 30+ years' experience	Senior GIS Analyst

Chapter 26
References

Executive Summary

Ayres Associates. 2008. *2008—Field Reconnaissance Report of Bank Erosion Sites and Site Priority Ranking, Sacramento River Flood Control Levee, Tributaries and Distributaries*. Sacramento River Bank Protection Project, Contract No. WA91238-07-D-0038, Modification to Task Order 2. Prepared for U.S. Army Corps of Engineers, Sacramento District. December 18. Sacramento, CA, and Fort Collins, CO.

Kleinfelder-Geomatrix. 2009. *Final Alternatives Report—80,000 LF (107 Sites), Sacramento River Bank Protection Project*. Contract No. W91238-08-D-0015. April 3. Prepared for U.S. Army Corps of Engineers, Sacramento District. Sacramento, CA.

U.S. Army Corps of Engineers. 1972. *Sacramento River Bank Protection Project, California—Second Phase.* Report of the Chief of Engineers, Department of the Army.

U.S. Army Corps of Engineers. 2013. *2012 Annual Erosion Reconnaissance Engineering Report, Sacramento River Bank Protection Project, Sacramento River and Tributaries*. February.

U.S. Army Corps of Engineers. 2014. *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures*. ETL 1110-2-583. April 30. Washington, D.C.

Chapter 1: Introduction

Ayres Associates. 2008. *2008—Field Reconnaissance Report of Bank Erosion Sites and Site Priority Ranking, Sacramento River Flood Control Levee, Tributaries and Distributaries*. Sacramento River Bank Protection Project, Contract No. WA91238-07-D-0038, Modification to Task Order 2. Prepared for U.S. Army Corps of Engineers, Sacramento District. December 18. Sacramento, CA, and Fort Collins, CO.

U.S. Army Corps of Engineers. 2013. 2012 *Annual Erosion Reconnaissance Engineering Report, Sacramento River Bank Protection Project, Sacramento River and Tributaries*. February.

Chapter 2: Project Description

Ayres Associates. 2008. *2008—Field Reconnaissance Report of Bank Erosion Sites and Site Priority Ranking, Sacramento River Flood Control Levee, Tributaries and Distributaries*. Sacramento River Bank Protection Project, Contract No. WA91238-07-D-0038, Modification to Task Order 2. Prepared for U.S. Army Corps of Engineers, Sacramento District. December 18. Sacramento, CA, and Fort Collins, CO.

Kleinfelder-Geomatrix. 2009. *Final Alternatives Report—80,000 LF (107 Sites), Sacramento River Bank Protection Project*. Contract No. W91238-08-D-0015. April 3. Prepared for U.S. Army Corps of Engineers, Sacramento District. Sacramento, CA.

Stillwater Sciences. 2007. *Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II (Final)*. Contract No. W91238-05-D-0009. Prepared for U. S. Army Corps of Engineers, Sacramento District. October. Davis, CA.

U.S. Army Corps of Engineers. 2011. *Sacramento River Bank Protection Project: Site Selection Process for Bank Repairs*. November 23.

U.S. Army Corps of Engineers. 2014. *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures*. ETL 1110-2-583. April 30. Washington, D.C.

Chapter 3: Guide to Effects Analysis

None.

Chapter 4: Flood Control and Geomorphology

Abernethy, B. and Rutherfurd, I.D. 1998. Where Along a River's Length Will Vegetation Most Effectively Stabilize Streambanks? *Geomorphology* 23: 55–75.

Andrews, W. F. 1972. *Soil Survey of Yolo County, California*. USDA Soil Conservation Service in cooperation with the University of California Agricultural Experiment Station. U.S. Government Printing Office. Washington, D.C.

Annandale, G.W. 1995. Erodibility. *Journal of Hydraulic Research* 33(4): 471–494.

Annandale, G. W. and Parkhill, D. L. 1995. Stream Bank Erosion: Application of Erodibility Index Method. In: W. H. Espey. and P. G. Combs, (eds.), *The First International Conference of Water Resources Engineering*. American Society of Civil Engineers. San Antonio, TX. Pp. 1570–1574.

Atwater, B. F. 1982. *Geologic Maps of the Sacramento-San Joaquin Delta, California*. U.S. Geological Survey Miscellaneous Field Studies Map MF-1401.

Ayres Associates. 2008. *Field Reconnaissance Report of Bank Erosion Sites and Site Priority Ranking, Sacramento River Flood Control Levees, Tributaries, and Distributaries*. Sacramento River Bank Protection Project, Contract No. WA91238-07-D-0038, Modification to Task Order 2. December 18. Fort Collins, CO. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

Ayres Associates. 1997. *Sacramento River Bank Protection Project, Sacramento River and Tributaries, Hydrodynamic Modeling of the Sacramento River and Butte Basin from RM 174 to RM 194*. December. Fort Collins, CO. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

Baker, V. R. and J. E. Costa. 1987. Floodpower. In: L. Mayer and D. Nash (eds.), *Catastrophic Flooding*. George Allen and Unwin: Boston, MA. Pp. 1–21.

Bisson, P. A. and Montgomery, D. R., 1996. Valley Segments, Stream Reaches, and Channel Units. In: F. R. Hauer and G. A. Lamberti (eds.), *Methods in Stream Ecology*. Academic Press: San Diego, CA. Pp. 23–52.

Brice, J. 1977. *Lateral Migration of the Middle Sacramento River, California*. Water-Resources Investigations 77-43. U. S. Geological Survey. Menlo Park, CA.

Brizga, S.O. and Finlayson, B.L., 1990. Channel Avulsion and River Metamorphosis: The Case of the Thomson River, Victoria, Australia. *Earth Surface Processes and Landforms* 15 (5): 391–404.

Buer, K. 1984. *Middle Sacramento River Spawning Gravel Study*. California Department of Water Resources, Northern District. Red Bluff, CA.

California Department of Water Resources. 2009. Office of Water Use Efficiency, California Irrigation Management System. Monthly data. Last updated: 2005. Available at: <http://wwwcimis.water.ca.gov/cimis/frontMonthlyReport.do>. Accessed: January 27, 2009.

California Department of Water Resources. 1994. *Sacramento River Bank Erosion Investigation Memorandum Progress Report*. Internal memorandum to R. Scott and L. Brown from K. Buer, Chief, Geology Section, California Department of Water Resources, Northern District. Red Bluff, CA.

Deer Creek Watershed Council. 1998. *Deer Creek Watershed Management Plan*. Vina, CA.

Engineer Research and Development Center. 2011. *Initial Research into the Effects of Woody Vegetation on Levees*. July. Prepared for: Headquarters, U.S. Army Corps of Engineers, Washington, D.C.

Gilbert, G. K. 1917. *Hydraulic Mining Debris in the Sierra Nevada*. U.S. Geological Survey Professional Paper 105.

Graf, W. L. 1983. The Arroyo Problem—Paleohydrology and Paleohydraulics in the Short Term. In: K. J. Gregory (ed.), *Background to Paleohydrology: A Perspective*. John Wiley and Sons: Chichester, England. Pp. 279–302.

Hall, W. H. 1880. *Report of the State Engineer to Legislature of California, 23rd Session, Part 3*. Sacramento, CA.

Harvey, C. 2002. Personal communication. California Department of Fish and Game, Redding, CA. Cited in Stillwater Sciences 2007.

Harvey, M. D. 1988. *Meanderbelt Dynamics of the Sacramento River, California*. Proceedings of the 2nd California Riparian Systems Conference. Davis, CA.

Helley, E. J., and D. S. Harwood. 1985. *Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California*. U.S. Geological Survey miscellaneous field studies map MF-1790, 24 p., scale 1:62,500, 5 sheets.

Hooke, J. M. 1979. An Analysis of the Process of River Bank Erosion. *Journal of Hydrology* 42: 39–62.

Hooke, J. M. 1980. Magnitude and Distribution of Rates of River Bank Erosion. *Earth Surface Processes* 5: 143–157.

Jones & Stokes Associates. 1987. *EIR/SEIS for the Sacramento River Bank Protection Project*. Final. December 21. Sacramento, CA. Prepared for the U.S. Army Corps of Engineers, Sacramento District, and the California Resources Agency, Sacramento, CA.

Katibah, E. F. 1984. A Brief History of Riparian Forests in the Central Valley of California. In: R. E. Warner and K. M. Hendrix (eds.), *California Riparian Systems*. University of California Press: Berkeley and Los Angeles, CA.

Kleinfelder-Geomatrix. 2009. *Final Alternatives Report—80,000 LF (107 Sites), Sacramento River Bank Protection Project*. Contract No. W91238-08-D-0015. April 3. Sacramento, CA. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

Knighton, A. D. 1999. Downstream Variation in Stream Power. *Geomorphology* 29: 293–306.

Larsen, E. W., and S. E. Greco. 2002. Modeling Channel Management Impacts on River Migration: A Case Study of Woodson Bridge State Recreation Area, Sacramento River, California, USA. *Environmental Management* 30:209–224.

Larsen, E. W., E. H. Girvetz, and A. K. Fremier. 2004. *Assessing the Effects of Alternative Setback Levee Scenarios Employing a River Meander Migration Model*. University of California, Davis, Department of Environmental Design. Davis, CA.

Larsen, E. W., S. G. Schladow, and J. F. Mount. 1997. *The Geomorphic Influence of Bank Revetment on Channel Migration: Upper Sacramento River, Miles 218–206*. Paper presented at Environmental and Coastal Hydraulics: Protecting the Aquatic Habitat. Theme B: Water for a Changing Global Community. The 27th Congress of the International Association for Hydraulic Research. New York.

Lawler, D. M. 1992. *Process Dominance in Bank Erosion Systems*. In: Carling, P. A. and G. E. Petts, (eds.), Lowland Floodplain Rivers: Geomorphological Perspectives. John Wiley and Sons: Chichester, England. Pp. 117–143.

Lawler, D. M. 1995. The Impact of Scale on the Processes of Channel-Side Sediment Supply: A Conceptual Model. In: W. R. Osterkamp (ed.), *Effects of Scale on Interpretation and Management of Sediment and Water Quality*. IAHS Press: Wallingford, U.K. Pp. 175–184.

Lawler, D. M., C. R. Thorne, and J. M. Hooke. 1997. Bank Erosion and Instability. In: C. R. Thorne, R. D. Hey, and M. D. Newson (eds.), *Applied Fluvial Geomorphology for River Engineering and Management*. John Wiley and Sons: New York. Pp. 137–172.

Limerinos, J. T. and W. Smith. 1975. *Evaluation of the Causes of Levee Erosion in the Sacramento-San Joaquin Delta, California*. Water Resources Investigations 28–74. Prepared in cooperation with California Department of Water Resources. U. S. Geological Survey. Menlo Park, CA.

Luk, S. 1982. Variability of Rainwash Erosion within Small Sample Areas. In: C. R. Thorne, (ed.), *Space and Time in Geomorphology*. George Allen and Unwin: London. Pp. 243–268.

Magilligan, F. J. 1992. Thresholds and the Spatial Variability of Flood Power During Extreme Events. *Geomorphology* 5: 373–390.

Micheli, E. R., J. W. Kirchner, and E. W. Larsen. 2004. Quantifying the Effect of Riparian Forest Versus Agricultural Vegetation on River Meander Migration Rates, Central Sacramento River, California, USA. *River Research and Applications* 20: 537–548.

Miller, A. J. 1995. Valley Morphology and Boundary Conditions Influencing Spatial Patterns of Flood Flow. In: J. E. Costa, A. J. Miller, K. W. Potter, and P. R. Wilcock (eds.), *Natural and Anthropogenic Influences in Fluvial Geomorphology*. The Wolman Volume. American Geophysical Union: Washington, D.C. Pp. 57–81.

Miller, A. J. 1990. Flood Hydrology and Geomorphic Effectiveness in the Central Appalachians. *Earth Surface Processes and Landforms* 15: 119–134.

Montgomery, D. R. and J. M. Buffington. 1998. Channel Processes, Classification, and Response. In: R. Naiman and R. Bilby (eds.), *River Ecology and Management*. Springer-Verlag: New York. Pp. 13–42.

Nanson, G. C., and H. F. Beach. 1977. Forest Succession and Sedimentation on a Meandering-River Floodplain, Northeast British Columbia, Canada. *Journal of Biogeography* 4: 229–251.

Northwest Hydraulic Consultants. 2007. *West Sacramento Levees System: Problem Identification Report, Erosion Assessment and Treatment Alternatives*. Draft for review. September. West Sacramento, CA. Prepared for HDR Engineering and Jones & Stokes.

Northwest Hydraulic Consultants. 2006. *North Delta Sedimentation Study*. March. West Sacramento, CA. Prepared for California Department of Water Resources.

Northwest Hydraulic Consultants, Inc. 2005. *Sacramento River Bank Erosion Site Evaluation for RM 49.6, 49.9, 50.2, 50.8, 51.5 & 53.1*. February. West Sacramento, CA. Prepared for Sacramento Area Flood Control Agency.

Northwest Hydraulic Consultants. 2003. *Assessment of Sediment Budget of Sacramento San Joaquin Delta*. West Sacramento, CA.

Odgaard, A. J. and J. F. Kennedy. 1983. River-Bend Bank Protection by Submerged Vanes. *Journal of Hydraulic Engineering* 109 (8): 1161–1173.

Rutherford, I. D., K. Jerie, and M. Wright. 1995. Vegetation and Stream Stability: A Scale Analysis. In: W. H. Espey and P. G. Combs (eds.), *The First International Conference of Water Engineering*. American Society of Civil Engineers. San Antonio, TX. Pp. 800–804.

Ryan, S. E. 1992. Riparian Vegetation and Bank Stability in a Subalpine Forest Environment. *Transactions of the American Geophysical Union* 73 (43): 231–232.

Saucedo, G. J., and D. L. Wagner. 1992. *Geologic Map of the Chico Quadrangle*. California Division of Mines and Geology. Sacramento, CA.

Schumm, S. A. 1977. *The Fluvial System*. John Wiley and Sons: New York.

Simon, A., A. Curini, S. E. Darby, and E. J. Langendoen. 2000. Bank and Near-Bank Processes in an Incised Channel. *Geomorphology* 35 (3-4): 193–217.

Stillwater Sciences. 2007. *Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II*. Final. Contract No. W91238-05-D-0009. October. Davis, CA. Prepared for U. S. Army Corps of Engineers, Sacramento District, Sacramento CA.

Thompson, K. 1961. Riparian Forests of the Sacramento Valley, California. In: R. S. Platt (ed.), *Annals of the Association of American Geographers*. Pp. 294–315.

Thorne, C. R. 1982. Processes and Mechanisms of Riverbank Erosion. In: R. D. Hey, J. C. Bathurst, and C. R. Thorne (eds.), *Gravel-Bed Rivers: Fluvial Processes, Engineering and Management*. John Wiley and Sons: New York. Pp. 227-271.

Thorne, C. R. and A. M. Osman. 1987. Influence of Outer Bank Stability on the Point Bar Profile at a Bend. *Transactions of the American Geophysical Union* 68 (44): 1293.

Thorne, C. R. and N. K. Tovey. 1981. Stability of Composite River Banks. *Earth Surface Processes and Landforms* 6: 469–484.

Tompkins, M., and G. M. Kondolf. 2007. *Lower Deer Creek Restoration and Flood Management Feasibility Study and Conceptual Design*. Existing conditions: Hydrology and geomorphology technical memorandum. Final. ERP-02D-P53 (Task 4.2). June.

U.S. Army Corps of Engineers. 2009. *Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites, Sacramento River Bank Protection Project*. Draft. Prepared by North State Resources, Redding, CA, and Stillwater Sciences, Berkeley, CA.

U.S. Army Corps of Engineers. 2006. *Sacramento River, River Mile 40 to 60—Rock Riprap Gradation Design for River Currents, Wind and Boat Waves*. January. Sacramento District. Sacramento, CA.

U.S. Army Corps of Engineers. 2004. *Standard Assessment Methodology for the Sacramento River Bank Protection Project*. Final report. Prepared by Stillwater Sciences, Davis, CA, and Dean Ryan Consultants & Designers, Sacramento, CA, for and in conjunction with U.S. Army Corps of Engineers and The Reclamation Board. Sacramento, CA.

U.S. Army Corps of Engineers. 1981. *Sacramento River and Tributaries Bank Protection and Erosion Control Investigation, California, Study of Alternatives*. Sacramento, CA.

U.S. Army Corps of Engineers. 1972. *Environmental Statement, Sacramento River Bank Protection Project, California*. Final. Sacramento, CA.

U.S. Fish and Wildlife Service. 2001. *Biological Opinion on the Sacramento River Bank Protection Project (SRBPP) on the Lower Sacramento River in Solano, Sacramento, Yolo, Sutter, Colusa, Glenn, Butte, and Tehama Counties, California*. Revised Final. File Number 1-1-00-F-0126.

Veres, J. 1987. Project Manager (Engineer). Sacramento River Bank Protection Project, U. S. Army Corps of Engineers, Sacramento District, Civil Design Division, Sacramento, CA. Memo, telephone conversations, and meetings, February–May. Cited in Jones & Stokes Associates 1987.

WET. 1990a. *Geomorphic Analysis and Bank Protection Alternatives Report for Sacramento River (RM 78–194) and Feather River (RM 0–28)*. Contract No. DACW05-88-D0044. Deliver Order #5. May. Fort Collins, CO. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento CA.

WET 1990b. *Geomorphic Analysis of the Sacramento River*. Phase II Report. Fort Collins, CO. Prepared for U.S. Army Corps of Engineers.

WET. 1989. *Geomorphic Analysis of Reach from Colusa to Red Bluff Diversion Dam, River Mile 143 to River Mile 243*. Final Phase II Report. Report No. DACWO5-87-C-0094. Fort Collins, CO. Prepared for U.S. Army Corps of Engineers.

WET. 1988. *Geomorphic Analysis of the Sacramento River*. Draft report DACWO5-87-C-0084. Fort Collins, CO. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

Woodward-Clyde Consultants. 1986. *Environmental Impact Report for the Butte Basin Overflow Area*. Walnut Creek, CA. Prepared for California Reclamation Board, Sacramento, CA.

Chapter 5: Water Quality and Groundwater Resources

California Department of Water Resources. 2003. *California's Groundwater—Bulletin 118*. Available: <http://www.water.ca.gov/groundwater/bulletin118/bulletin118update2003.cfm>. Accessed: August 5, 2009.

California Regional Water Quality Control Board. 2011. *Water Quality Control Plan (Basin Plan) for The Sacramento River Basin and The San Joaquin River Basin*. Fourth Edition. Available: <http://www.swrcb.ca.gov/rwqcb5/water_issues/basin_plans/>.

California State Water Resources Control Board. 2006. *CWA Section 303(d) List of Water Quality Limited Segments Requiring TMDLs*. Available: <http://www.swrcb.ca.gov/water_issues/programs/tmdl/docs/303dlists2006/epa/r5_06_303d_reqtmdls.pdf>. Accessed: July 16, 2009.

Murphy, S. 2009. *General Information on Turbidity*. Prepared for City of Boulder, USGS Water Quality Monitoring. Available: <http://bcn.boulder.co.us/basin/data/BACT/info/Turb.html>. Accessed: August 6, 2009>.

Sacramento County. 2008. *American River Parkway Plan*. Planning and Community Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/parks/Pages/ParkwayPlan.aspx >. Accessed: August 2009.

Sacramento River Watershed Program. 2012. *Tehama West Watershed*. Available: <http://www.sacriver.org/aboutwatershed/roadmap/watersheds/westside/tehama-west-watershed>. Accessed: August 2, 2012.

Travers, B. 1998. *Deer Creek History: A Report to the Deer Creek Watershed Conservancy*. Draft. July 3. California State University, Chico.

U.S. Army Corps of Engineers. 2009. *Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites, Sacramento River Bank Protection Project*. Prepared by North State Resources, Redding, CA, and Stillwater Sciences, Berkeley, CA.

U.S. Army Corps of Engineers. 2008. *Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009, Sacramento River Bank Protection Project, Sacramento River and Tributaries, California*. Final report. Prepared by Parus Consulting, Roseville, CA, and Ayres Associates, Sacramento, CA.

U.S. Army Corps of Engineers. 2006a. *Environmental Assessment/Initial Study for Five Critical Erosion Sites—River Miles 26.9 Left, 34.5 Right, 72.2 Right, 99.3 Right, and 123.5 Left, Sacramento River Bank Protection Project*. Final report. Prepared by Stillwater Sciences, Davis, CA, and Ayres Associates, Sacramento, CA.

U.S. Army Corps of Engineers. 2006b. *Environmental Assessment for Levee Repair of 14 Winter 2006 Critical Sites, Sacramento River Bank Protection Project*. Final report. Prepared by Stillwater Sciences, Arcata, CA, and Ayres Associates, Sacramento, CA.

U.S. Geological Survey. 2009a. *Aquatic Ecology: Cycle 1 Activities (1994-2004)*. Sacramento River Basin national water-quality assessment program. Last revised: May 8, 2007. Available: <http://ca.water.usgs.gov/sac_nawqa/ae_cycle1.html#AE_IEI>. Accessed: July 16, 2009.

U.S. Geological Survey. 2009b. *Groundwater Availability of the Central Valley Aquifer, California*. C. C. Faunt, editor. Professional Paper 1766. Reston, VA. Available: <http://pubs.usgs.gov/pp/1766/PP_1766.pdf>. Accessed: August 12, 2009.

Chapter 6: Geology, Seismicity, Soils, and Mineral Resources

Association of Bay Area Governments. 2001. *The Real Dirt on Liquefaction: A Guide to the Liquefaction Hazard in Future Earthquakes Affecting the San Francisco Bay Area*. Oakland, CA.

Butte County. 2005. *Butte County General Plan Technical Update, Background Report*. Final Draft. August 8.

California Division of Mines and Geology. 1997. *Guidelines for Evaluating and Mitigating Seismic Hazards in California*. Special Publication 117. Sacramento, CA.

California Geological Survey. 2002. *California Geomorphic Provinces*. Available: <http://www.consrv.ca.gov/cgs/information/publications/cgs_notes/note_36/Documents/note_36.pdf>. Accessed: May 7, 2009.

Clinkenbeard, J.P. 2012. *Aggregate Sustainability in California*. California State Geological Survey Map Sheet 52 (Updated 2012).

Hackel, O. 1966. Summary of the Geology of the Great Valley. In: E.G. Bailey (ed.), *Geology of Northern California*. California Division of Mines and Geology Bulletin 190: 217–238. San Francisco, CA.

Harwood, D. S. and E. J. Helley. 1987. *Late Cenozoic Tectonism of Sacramento Valley, California*. U.S. Geological Survey Professional Paper 1359.

Hart, E. W., and W. A. Bryant. 1997. *Fault-Rupture Hazard Zones in California: Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zone Maps*. Special Publication 42. California Division of Mines and Geology. Sacramento, CA.

Helley, E. J., and D. S. Harwood. 1985. *Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California*. U.S. Geological Survey miscellaneous field studies map MF-1790, 24 p., scale 1:62,500, 5 sheets.

International Conference of Building Officials. 1997. *Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada: To be Used with 1997 Uniform Building Code*. Whittier, CA.

Jennings, C. W. 1994. *Fault Activity Map of California and Adjacent Areas*. California Geologic Data Map Series. California Division of Mines and Geology. Sacramento, CA.

Jennings, C. W. 1977. *Geologic Map of California*. Geologic Data Map No. 2. California Division of Mines and Geology. Sacramento, CA.

Jennings, C. W., and R. G. Strand. 1960. *Geologic Map of California: Ukiah Sheet*. California Division of Mines and Geology. Sacramento, CA.

Jordan, T. H., and J. B. Minster. 1988. Measuring Crustal Deformation in the American West. *Scientific American*, August 1988: 48–58.

Kleinfelder, Inc. 2008. *Preliminary Geologic and Geotechnical Information, Proposed Palermo-Nicolaus Transmission Line, Butte, Yuba and Sutter Counties, California*. Letter report prepared for Mr. Wei-Chih Huang, Black & Veatch Corporation, Dublin, CA. September 10. Sacramento, CA.

Kleinfelder, Inc. 2007. *Problem Identification Report and Alternatives Analysis Reaches 1, 3, 4, and 9*. Volume 1—geotechnical problem identification, Solano and Yolo Counties, CA. June 12. Prepared for HDR Engineering.

Northwest Hydraulic Consultants. 2007. *West Sacramento Levees System: Problem Identification Report, Erosion Assessment and Treatment Alternatives*. Draft for review. September. West Sacramento, CA. Prepared for HDR Engineering/Jones & Stokes.

Saucedo, G. J., and D. L. Wagner. 1992. *Geologic Map of the Chico Quadrangle*. California Division of Mines and Geology, Regional Geologic Map No. 7A, scale 1:250000. Sacramento, CA.

Sutter County. 2008. *General Plan Update Technical Background Report*. February. Prepared by PBS&J. Available: <http://www.suttercounty.org/doc/government/depts/cs/ps/gp/gp_documents#background>. Accessed: August 2, 2012.

Tokimatsu, K., and H. B. Seed. 1984. *Simplified Procedures for the Evaluation of Settlements in Clean Sands*. Report No. UCB/BT-84/16. Earthquake Engineering Research Center. University of California, Berkeley, CA.

U.S. Geological Survey. 2009. Earthquake Hazards Program—Database Search. Last Updated: January 29, 2009. Available: <http://gldims.cr.usgs.gov/webapps/cfusion/Sites/qfault/index.cfm>. Accessed: August 12, 2009.

Wagner, D. L., and E. J. Bortugno. 1982. *Geologic Map of the Santa Rosa Quadrangle, California*. California Division of Mines and Geology, Regional Geologic Map No. 2A, scale 1:250,000. Sacramento, CA.

Wagner, D. L., C. W. Jennings, T. L. Bedrossian, and E. J. Bortugno. 1987. *Geologic Map of the Sacramento Quadrangle*. California Division of Mines and Geology, Regional Geologic Map No. 7A, scale 1:250000. Sacramento, CA.

WET (Water Engineering & Technology). 1990. *Geomorphic Analysis and Bank Protection Alternatives Report for Sacramento River (RM 78-194) and Feather River (RM 0-28)*. Contract No.

DACW05-88-D0044, Deliver Order No. 5. May. Fort Collins, CO. Prepared for U.S. Army Corps of Engineers, Sacramento District.

William Lettis & Associates. 2007. *Surficial Geologic Mapping and Geomorphic Assessment, California Department of Water Resources Urban Levees, West Sacramento, California*. Tech Memo to Mr. Robert Green, URS Corporation, Oakland, CA. April 9.

Yuba County. 2008. *Yuba County General Plan, General Plan Update Background Report*. January.

Zoback, M. D. et al. 1987. New Evidence on the State of Stress of the San Andreas Fault System. *Science* 238: 1105–1111.

Chapter 7: Transportation and Navigation

Butte County. 2010. *Butte County General Plan 2030*. Adopted October 26, 2010. Oroville, CA. Available: <http://www.buttegeneralplan.net/>. Accessed: June 28, 2012.

Colusa County. 2011. *Colusa County Draft General Plan 2030*. November. Prepared by De Novo Planning Group. Sacramento, CA. Available: <http://countyofcolusageneralplan.org/sites/default/files/PublicReview_GP_Colusa_County_web.pdf>. Accessed: June 28, 2012.

Glenn County. 1993. *Glenn County General Plan*. Vol. 1—Policies. Adopted June 15. Planning and Public Works Agency. Willows, CA. Available: <http://www.gcplanupdate.net/_documents/docs/VOLUME%20I-POLICIES-1.pdf>. Accessed: June 28, 2012.

Placer County. 1994. *Placer County General Plan Update*. Adopted August 16. Community Development Resource Agency. Auburn, CA. Available: <http://www.placer.ca.gov/Departments/CommunityDevelopment/Planning/Documents/CommPlans/PCGP.aspx>. Accessed: June 28, 2012

Sacramento County. 2011. *Sacramento County General Plan of 2005-2030*. Adopted November 9. Community Planning and Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/planning/Pages/GeneralPlan.aspx>. Accessed: July 11, 2012.

Solano County. 2008. *Solano County General Plan*. November. Department of Resource Management, Planning Services Division. Fairfield, CA. Available: <http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp>. Accessed: July 11, 2012.

Sutter County. 2011. *Sutter County General Plan*. Adopted March 29. Yuba City, CA. Available: <http://www.co.sutter.ca.us/pdf/cs/ps/General_Plan_Policy_Document.pdf>. Accessed: June 28, 2012.

Tehama County. 2009. *Tehama County General Plan*. March. Prepared by PMC. Chico, CA. Available: <http://www.tehamagp.com/documents/final_general_plan/Tehama%20County%20General%20Plan%20March%202009.pdf>. Accessed: June 28, 2012.

Yolo County. 2009. *Yolo County 2030 Countywide General Plan*. Adopted November 10. Planning and Public Works Department. Woodland, CA. Available: <http://www.yolocounty.org/Index.aspx?page=1965>. Accessed: July 11, 2012.

Yuba County. 2011. *Yuba County 2030 General Plan*. Adopted June 7. Community Development and Services Agency. Marysville, CA. Available: <http://www.yubavision2030.org/2030%20General%20Plan.aspx>. Accessed: June 28, 2012.

Chapter 8: Air Quality and Climate Change

Printed References

Bay Area Air Quality Management District. 2012. *BAAQMD CEQA Guidelines*. May. San Francisco, CA. Available: <http://www.baaqmd.gov/Divisions/Planning-and-Research/CEQA-GUIDELINES/Updated-CEQA-Guidelines.aspx >. Accessed: July 12, 2012.

Butte County Air Quality Management District. 2008. *CEQA Air Quality Handbook: Guidelines for Assessing Air Quality Impacts for Projects Subject to CEQA Review*. January. Chico, CA. Available: <http://www.bcaqmd.org/page/_files/CEQA-Handbook-and-Appxs-08.pdf>. Accessed: August 10, 2009.

California Air Resources Board. 2012a. ARB Air Quality Databases: Aerometric Data Analysis and Management System (ADAM)—Top 4 Summary. Available: <http://www.arb.ca.gov/adam/topfour/topfour1.php>. Accessed: July 12, 2012.

California Air Resources Board. 2012b. *Area Designation Maps/State and National.* Last revised: May 8, 2012. Available: <http://www.arb.ca.gov/desig/adm/adm.htm>. Accessed: July 12, 2012.

California Air Resources Board. 2012c. *Ambient Air Quality Standards.* June 7. Available: <http://www.arb.ca.gov/research/aaqs/aaqs2.pdf>. Accessed: July 12, 2012.

California Air Resources Board. 2012d. *Greenhouse Gas Inventory Data—2000 to 2009*. Last revised: April 6. Available: < http://www.arb.ca.gov/cc/inventory/data/data.htm >. Accessed: July 12, 2012.

California Air Resources Board. 2000. *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*. Stationary Source Division, Mobile Source Control Division. Sacramento, CA. October. Available: <http://www.arb.ca.gov/diesel/documents/rrpfinal.pdf>. Accessed: August 12, 2009.

California Energy Commission. 2009. *Climate Change Scenarios and Sea Level Rise Estimates for California 2008 Climate Change Scenario Assessment*. Draft Paper. March. Available: <http://www.energy.ca.gov/2009publications/CEC-500-2009-014/CEC-500-2009-014-D.PDF>. Accessed: January 2012.

California Natural Resources Agency. 2009. *2009 California Climate Adaptation Strategy*. Available: <http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-F.PDF>. Accessed: January 2012.

Coastal and Ocean Working Group of the California Climate Action Team. 2010. *State of California Sea-level Rise Interim Guidance Document*. October. Available: <http://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20110311/12.SLR_Resolution/SLR-Guidance-Document.pdf>. Accessed: March 25, 2013.

Feather River Air Quality Management District. 2010. *Indirect Source Review Guidelines- A technical Guide to Access the Air Quality Impact of Land Use Projects Under the CEQA.* Yuba City, CA. Last Revised: June 7, 2010. Available: <http://www.fraqmd.org/CEQA%20Planning.html>. Accessed: July 12, 2012.

ICF Jones & Stokes. 2009. *GHG Emissions Inventory for Incorporated and Unincorporated Sacramento County*. ICF J&S 00310.08. June. Sacramento, CA. Prepared for Sacramento County Department of Environmental Review and Assessment. Sacramento, CA.

National Oceanic and Atmospheric Administration. 2005. *Greenhouse Gases: Frequently Asked Questions*. Available: <http://lwf.ncdc.noaa.gov/oa/climate/gases.html>. Accessed: September 22, 2009.

Parus Consulting and Ayres Associates. 2008. *Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009*. Final report. Volume I. Contract: W91238-07-D-0038. July 16. Sacramento and Roseville, CA. Prepared for U.S. Army Corps of Engineers and Central Valley Flood Protection Board, Sacramento, CA.

Rogner, H. H., D. Zhou, R. Bradley. P. Crabbé, O. Edenhofer, B. Hare, L. Kuijpers, and M. Yamaguchi. 2007. *Climate Change 2007: Mitigation*. Introduction. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, U.K. and New York, NY: Cambridge University Press. Available: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter1.pdf>. Accessed: July 28, 2009.

Sacramento Metropolitan Air Quality Management District. 2011. *Guide to Air Quality Assessment in Sacramento County.* Last revised: June 2011. Available: <http://www.airquality.org/ ceqa/ceqaguideupdate.shtml>. Accessed: July 12, 2012.

Tehama County Air Pollution Control District. 2009. *Planning and Permitting Air Quality Handbook—Guidelines for Accessing Air Quality Impacts*. December. Red Bluff, CA. Available: <http://www.tehcoapcd.net/Proposed.php >. Accessed: July 12, 2012.

The Weather Channel. 2009a. *Monthly Averages for Sacramento, CA.* Available: <http://www.weather.com/weather/wxclimatology/monthly/USCA0967>. Accessed: August 11, 2009.

The Weather Channel. 2009b. *Monthly Averages for Martinez, CA.* Available: <http://www.weather.com/weather/wxclimatology/monthly/USCA0675>. Accessed: August 11, 2009.

U.S. Environmental Protection Agency. 2012a. *The Green Book Nonattainment Areas for Criteria Pollutants.* Last revised: March 30, 2012. Available: <http://www.epa.gov/oaqps001/greenbk/index.html>. Accessed: July 12, 2012.

U.S. Environmental Protection Agency. 2012b. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010*. EPA 430-R-12-001. April. Available <http://epa.gov/climatechange/emissions/usinventoryreport.html> Accessed: June 2012.

U.S. Environmental Protection Agency. 2012c. *Air Data: Access to Monitored Air Quality Data from EPA's Air Quality System Data Mart*. Last Updated: June 12, 2012. Available: <http://www.epa.gov/airdata/>. Accessed: July 12, 2012.

Yolo-Solano Air Quality Management District. 2007. *Handbook for Assessing and Mitigating Air Quality Impacts.* July 11. Davis, CA. Available: <http://ysaqmd.omsoft.com/documents/CEQAHandbook2007.pdf>. Accessed: August 10, 2009.

Personal Communications

Chang, Yu-Shuo. Air Quality Planner. Placer County Air Pollution Control District, Auburn, CA. August 10, 2009. Email message to Shannon Hill of ICF International regarding the air pollutant emission thresholds.

Gomez, T. J. Air Pollution Standards Officer. Colusa County Air Quality Management District, Colusa, CA. August 18, 2009. Email message to Shannon Hill of ICF International regarding the air pollutant emission thresholds.

Gomez, T. J. Air Pollution Standards Officer. Colusa County Air Quality Management District, Colusa, CA. August 19, 2009. Email message to Shannon Hill of ICF International regarding the significant thresholds and mitigation measures.

Ledbetter, Ian. Glenn County Air Pollution Control District, Willows, CA. August 10, 2009. Email message to Shannon Hill of ICF International regarding the air pollutant emission thresholds.

Williams, Gail. Air Quality Planner. Butte County Air Quality Management District, Chico, CA. August 12, 2009 Email message to Shannon Hill of ICF International regarding the air pollutant emission thresholds.

Chapter 9: Noise and Vibration

California Department of Transportation. 2009. *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish.* Final. Prepared by ICF Jones & Stokes. Sacramento, CA.

California Department of Transportation. 2011. *Traffic Noise Analysis Protocol*. Sacramento, CA.

California Department of Transportation. 2013. *Transportation and Construction-Induced Vibration Guidance Manual*. Sacramento, CA.

California Department of Transportation. 2013. *Technical Noise Supplement: A Technical Supplement to the Traffic Noise Analysis Protocol*. California Department of Transportation Environmental Program. October.

Environmental Protection Agency. 1971. *Community Noise*. Report NTID300.1. Prepared by Wyle Laboratories.

Federal Highway Administration. 2006. *Roadway Construction Noise Model User's Guide*. Final Report. FHWA-HEP-05-054. Prepared by Volpe National Transportation Center. Washington DC.

Federal Transit Administration. 2006. *Transit Noise and Vibration Impact Assessment*. FTA-VA-90-1003-06. Washington DC.

Chapter 10: Vegetation and Wetlands

Butte County. 2010. *Butte County General Plan 2030*. Adopted October 26, 2010. Oroville, CA. Available: <http://www.buttegeneralplan.net/>. Accessed: July 30, 2012.

California Department of Fish and Game. 2009. California Natural Diversity Database, RareFind 3, Version 3.1.0. Updated May 2, 2009. Sacramento, CA. Accessed: June 31, 2009.

California Department of Fish and Game. 2003. *The Vegetation Classification and Mapping Program*. List of California terrestrial natural communities recognized by the California Natural Diversity Database. Wildlife and Habitat Data Analysis Branch. Sacramento, CA

California Department of Fish and Game. 2000. *Guidelines for Assessing the Effects of Proposed Projects on Rare, Threatened, and Endangered Plants and Natural Communities*. Appendix C. Adopted: December 9, 1983. Revised: May 8, 2000. Sacramento, CA.

California Department of Food and Agriculture. 2009. *Pest Ratings of Noxious Weed Species and Noxious Weed Seeds*. Available: <http://www.cdfa.ca.gov/phpps/ipc/weedinfo/winfo_list-pestrating.htm>. Accessed: May 27, 2009.

California Department of Water Resources. 2012. 2012 Central Valley Flood Protection Plan. June 2012. Sacramento, CA.

California Invasive Plant Council. 2007. New Weeds Added to Cal-IPC Inventory. *Cal-IPC News* 15(1/2):10. Available: <http://www.cal-ipc.org/ip/inventory/pdf/WebUpdate2007.pdf>.

California Invasive Plant Council. 2006. *California Invasive Plant Inventory*. February. Cal-IPC Publication 2006-02. Berkeley, CA. Available: <http://www.cal-ipc.org/ip/inventory/pdf/Inventory2006.pdf>.

California Native Plant Society. 2009. *Inventory of Rare and Endangered Plants*. Online edition, v7-09c. Last revised: July 14, 2009. Available: <http://cnps.web.aplus.net/cgi-bin/inv/inventory.cgi>. Accessed: July 31, 2009.

City of Sacramento, Sutter County, and The Natomas Basin Conservancy. 2003. *Natomas Basin Habitat Conservation Plan*. Final. Sacramento, CA.

Colusa County. 2011. *Colusa County Draft General Plan 2030*. Prepared by De Novo Planning Group. Sacramento, CA. November. Available: <http://countyofcolusageneralplan.org/sites/default/files/PublicReview_GP_Colusa_County_web.pdf>. Accessed: August 1, 2012.

Environmental Laboratory. 1987. *U.S. Army Corps of Engineers Wetlands Delineation Manual.* Technical Report Y-87-1. U.S. Army Waterways Experiment Station. Vicksburg, MS.

Glenn County. 1993. *Glenn County General Plan*. Volume I—Policies, Volume II—Issues, Volume III—Setting, and Volume IV—EIR. Adopted June 15. Planning and Public Works Agency. Willows, CA.

Gulf South Research Corporation. 2012. Final Vegetation and Habitat Monitoring Methodology Protocol for Sacramento River Bank Protection Project (SRBPP) Sites. Prepared for the U.S. Army Corps of Engineers. Baton Rough, LA. October.

ICF International. 2012. *Sacramento River Bank Protection Project, Phase II 80,000 Linear Feet Biological Assessment*. Draft. ICF 00627.08. July. Sacramento, CA. Prepared for U.S. Army Corps of Engineers, Sacramento, CA.

National Invasive Species Council. 2008. *2008–2012 National Invasive Species Management Plan*. Washington, DC.

Nelson, C., S. Cepello, J. Nelson, C. Martz, and J. Seperek. 2000. *Sacramento River Riparian Vegetation (SRRV) Coverage*. Draft report. Prepared by Chico Geographical Information Center, California State University, Chico.

Placer County. 1994. *Placer County General Plan Update*. Adopted August 16. Community Development Resource Agency. Auburn, CA. Available: http://www.placer.ca.gov/Departments/CommunityDevelopment/Planning/CommPlans/PCGP.aspx. Accessed: July 2009.

Sacramento County. 2011. *Sacramento County General Plan of 2005-2030*. Adopted November 9. Community Planning and Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/planning/Pages/GeneralPlan.aspx>. Accessed: August 2, 2012.

Sacramento County. 2008. *American River Parkway Plan*. Planning and Community Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/parks/Pages/ParkwayPlan.aspx >. Accessed: August 3, 2012.

Solano County. 2008. *Solano County General Plan*. November. Fairfield, CA. Available: <http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp>. Accessed: August 3, 2012.

Stillwater Sciences. 2007. *Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II (Final)*. Contract No. W91238-05-D-0009. October. Davis, CA. Prepared for U. S. Army Corps of Engineers, Sacramento District, Sacramento CA.

Sutter County. 2011. *Sutter County General Plan*. Adopted March 29. Yuba City, CA. Available: <http://www.co.sutter.ca.us/pdf/cs/ps/General_Plan_Policy_Document.pdf>. Accessed: August 2, 2012.

Tehama County. 2009. *Tehama County General Plan*. March. Prepared by PMC. Chico, CA. Available: <http://www.tehamagp.com/documents/final_general_plan/Tehama%20County%20General%20Plan%20March%202009.pdf>. Accessed: June 28, 2012.

U.S. Army Corps of Engineers. 2009. *Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites, Sacramento River Bank Protection Project*. Prepared by North State Resources, Redding, CA, and Stillwater Sciences, Berkeley, CA. April 2009.

U.S. Army Corps of Engineers. 2008. *Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009, Sacramento River Bank Protection Project, Sacramento River and Tributaries, California*. Final report. Prepared by Parus Consulting, Roseville, CA, and Ayres Associates, Sacramento, CA.

U.S. Army Corps of Engineers, Sacramento District. 2006a. *Environmental Assessment/Initial Study for Five Critical Erosion Sites—River Miles 26.9 Left, 34.5 Right, 72.2 Right, 99.3 Right, and 123.5*

Left, Sacramento River Bank Protection Project. Final report. Prepared by Stillwater Sciences, Davis, CA, and Ayres Associates, Sacramento. June 15.

U.S. Army Corps of Engineers. 2006b. *Environmental Assessment for Levee Repair of 14 Winter 2006 Critical Sites, Sacramento River Bank Protection Project*. Final report. Prepared by Stillwater Sciences, Arcata, CA, and Ayres Associates, Sacramento, CA.

U.S. Department of Agriculture Farm Service Agency. 2007. *National Agriculture Imagery Program (NAIP)*. NAIP, Aerial Photography Field Office, USDA Farm Service Agency. Salt Lake City, UT.

U.S. Fish and Wildlife Service. 2009. *List of Endangered and Threatened Species that May Occur in Butte, Colusa, Contra Costa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties*. Last revised: January 29, 2009. Available: <http://www.fws.gov/sacramento/es/spp_list.htm>. Accessed: July 22, 2009.

Yolo County. 2009. *Yolo County 2030 Countywide General Plan*. Adopted November 10. Planning and Public Works Department. Woodland, CA. Available: <http://www.yolocounty.org/Index.aspx?page=1965>. Accessed: July 11, 2012.

Yolo County. 2007. *Yolo County Oak Woodland Conservation and Enhancement Plan*. Adopted: January 16. Parks and Natural Resources Management Division, and Planning, Resources, and Public Works Department. Woodland, CA. Available: <http://www.yolocounty.org/Index.aspx?page=1318>. Accessed: July 2009.

Yuba County. 2011. *Yuba County 2030 General Plan*. Adopted June 7. Community Development and Services Agency. Marysville, CA. Available: <http://www.yubavision2030.org/2030%20General%20Plan.aspx>. Accessed: August 2, 2012.

Chapter 11: Fisheries and Aquatics

Adams, P. B., C. B. Grimes, J. E. Hightower, S. T. Lindley, M. L. Moser. 2002. *Status Review for North American Green Sturgeon,* Acipenser medirostris. June. Prepared for National Marine Fisheries Service and North Carolina Cooperative Fish and Wildlife Research Unit.

Alley, D. W., and H. W. Li. 1977. Significance of Microhabitat Selection for Fishes in A Sierra Foothill Stream. *California-Nevada Wildlife Transactions* 1977: 27–33.

Atwater, B. F. 1982. *Geologic Maps of the Sacramento-San Joaquin Delta, California*. U.S. Geological Survey Miscellaneous Field Studies Map MF-1401.

Baker, P. T., T. P. Speed, and F. K. Ligon. 1995. Estimating the Influence of Temperature on the Survival of Chinook Salmon Smolts Migrating through the Sacramento-San Joaquin River Delta of California. *Canadian Journal of Fisheries and Aquatic Science* 52: 855–863.

Beamesderfer, R., M. Simpson, G. Kopp. 2006. Use of Life History Information in a Population Model for Sacramento Green Sturgeon. *Environmental Biology of Fishes* 79: 315–337. September. DOI 10.1007/s10641-006-9145-x.

Bettelheim, M. 2001. *An Evaluation of Big Chico Creek, Lindo Channel, and Mud Creek as Salmonid Nonnatal Rearing Habitats—A Literature Review*. California Department of Fish and Game, Central Valley Bay Delta Branch. Available: <http://www.atlantismagazine.com/bettelheim/bigchico.pdf>. Accessed: July 10, 2009.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. In W.R. Meehan (ed.), *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats*. American Fisheries Society Special Publication 19. Bethesda, MD. Pp. 83–138.

Busby, J. R., T. C. Wainright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. *Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California*. NMFS-NWFSC -27. National Marine Fisheries Services. Seattle, WA.

CALFED Bay-Delta Program. 2000. *Multi-Species Conservation Strategy*. Final programmatic EIS/EIR technical appendix. July. Available: <http://calwater.ca.gov/content/Documents/library/310.pdf>. Accessed: July 28, 2009.

CALFED Bay-Delta Program. 1999. *Ecosystem Restoration Program Plan*. Volume 2—Ecological management zone visions.

California Department of Fish and Game. 2012. Delta Branch. Salvage data. Available: <ftp://ftp.delta.dfg.ca.gov/salvage/>. Accessed: August 8, 2012.

California Department of Fish and Game. 2009. *GrandTab California Central Valley Sacramento and San Joaquin River systems. Chinook salmon escapement. Hatcheries and natural areas. Date compiled: 2/18/2009. Winter-Run Chinook Salmon Population Estimates and Adult Chinook Salmon Escapement.* Available: <http://www.calfish.org/IndependentDatasets/CDFGFisheriesBranch/tabid/157/Default.aspx>. Accessed: March 25, 2013.

California Department of Fish and Game. 2008. Midwater trawl. Longfin smelt abundance indices (all ages). Updated January 5, 2008. Available: <http://www.delta.dfg.ca.gov/data/mwt/charts.asp>. Accessed: July 22, 2009.

California Department of Fish and Game. 2007. *GrandTab Spreadsheet of Adult Chinook Salmon Escapement in the Central Valley*. February.

California Department of Fish and Game. 2002. *California Department of Fish and Game Comments to NMFS Regarding Green Sturgeon Listing*.

California Department of Water Resources. 2007. *Oroville Facilities Relicensing—Environmental Impact Report*. Draft. May. FERC Project No. 2100. Available: <http://www.water.ca.gov/orovillerelicensing/DEIR_070521.cfm>. Accessed: July 1, 2009.

California Department of Water Resources. 2005. *California Water Plan Update 2005*. Department of Water Resources Bulletin 160-05. Sacramento, CA.

California Department of Water Resources. 2001. *Initial Information Package—Relicensing of the Oroville Facilities*. Federal Energy Regulatory Commission License Project. No. 2100. January.

California Department of Water Resources. 1995. *Management of the California State Water Project*. Bulletin 132-95. Sacramento, CA.

Chotkowski, M. 1999. List of Fishes Found in San Francisco Bay-Delta Shallow Water Habitats. *IEP Newsletter* 12(3): 12–18.

Daniels, R. A., and P. B. Moyle. 1983. Life History of Splittail (Cyprinidae: *Pogonichthys macrolepidotus*) in the Sacramento–San Joaquin Estuary. *Fishery Bulletin* 81(3): 647–653.

Everest, F. H. and D. W. Chapman. 1972. Habitat Selection and Spatial Interaction by Juvenile Chinook Salmon and Steelhead Trout in Two Idaho Streams. *Journal of the Fisheries Research Board of Canada* 29(1): 91–100.

Feather River Coordinated Resource Management. 2009. *Feather River Watershed*. Available: <http://www.feather-river-crm.org/frwater.htm>. Accessed: July 1, 2009.

Good, T. P., R. S. Waples, and P. Adams (eds). 2005. *Updated Status of Federally Listed ESU of West Coast Salmon and Steelhead*. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-66.

Grant, G. C., and P. E. Maslin. 1999. Movements and Reproduction of Hardhead and Sacramento Squawfish in a Small California Stream. *Southwest Association of Naturalists* 44: 296–310.

Hallock, R. J. 1989. *Upper Sacramento River Steelhead* Oncorhynchus Mykiss*, 1952–1988.* A report to the U.S. Fish and Wildlife Service. September 15.

Hallock, R. J., R. T. Elwell, and D. H. Fry. 1970. *Migrations of Adult King Salmon (*Oncorhynchus tshawytscha*) in the San Joaquin Delta as Demonstrated by the Use of Sonic Tags*. California Department of Fish and Game, Fish Bulletin 151. Sacramento, CA.

Hallock, R. J., W. F. Van Woert, and L. Shapovalov. 1961. *An Evaluation of Stocking Hatchery-Reared Steelhead Rainbow Trout (*Salmo gairdnerii gairdnerii*) in the Sacramento River System*. California Department of Fish and Game, Fish Bulletin No. 114. Sacramento, CA.

Healey, M. C. 1991. Life History of Chinook Salmon (*Oncorhynchus tshawytscha*). In: C. Groot and L. Margolis (eds.), *Pacific Salmon Life Histories*. University of British Columbia Press: Vancouver, British Columbia. Pp. 311–393.

Jackson, T. A. 1992. Microhabitat Utilization by Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) in Relation to Stream Discharges in the Lower American River of California. MS thesis. Oregon State University. Corvalis, OR.

Johnson, D. 2002. *Bear River Ecology*. Available: <http://bearriver.us/docs/ecology.pdf>. Accessed: July 2, 2009.

Jones & Stokes Associates. 1993. *Sutter Bypass Fisheries Technical Memorandum II: Potential Entrapment of Juvenile Chinook Salmon in the Proposed Gravel Mining Pond*. JSA 91-272. May 27. Sacramento, CA. Prepared for Teichert Aggregates, Sacramento, CA.

Kimmerer, W. J. 2002. Effects of Freshwater Flow on Abundance of Estuarine Organisms: Physical Effects or Trophic Linkages? *Marine Ecology Progress Series* 243: 39–55.

Kimmerer, W. and M. Nobriga. 2005. Development of Bootstrapped Confidence Intervals for the IEP Fish Abundance Indices. *Interagency Ecological Program Newsletter* 18(2): 68–75.

Kohlhorst, D. W., L. W. Botsford, J. S. Brennan, and G. M. Cailliet. 1991. Aspects of the Structure and Dynamics of an Exploited Central California Population of White Sturgeon (*Acipenser Transmontanus*). In: P. Williot (ed.) *Acipenser*. CEMAGREF: Bordeaux, France. Pp. 277–293.

Kynard, B., E. Parker, and T. Parker. 2005. Behavior of Early Life Intervals of Klamath River Green Sturgeon, *Acipenser Medirostris*, with a Note on Body Color. *Environmental Biology of Fishes* 72: 85–97.

Lindley, S. T., R. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for Assessing Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin. *San Francisco Estuary and Watershed Science* 5(1): Article 4. Available: <http://repositories.cdlib.org/jmie/sfews/vol5/iss1/art4>.

McCullough, D. A. 1999. *A Review and Synthesis of Effects of Alterations to the Water Temperature Regime on Freshwater Life Stages of Salmonids, with Special Reference to Chinook Salmon*. EPA 910-R-99-010. July. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, WA.

McEwan, D. R. 2001. *Central Valley Steelhead—Contributions to the Biology of Central Valley Salmonids*. R. Brown (ed.), California Department of Fish and Game, Fish Bulletin 179(1): 1–45.

McEwan, D. and T. A. Jackson. 1996. *Steelhead Restoration and Management Plan for California*. California Department of Fish and Game. Sacramento, CA.

Moyle, P. B. 2002. *Inland Fishes of California*. Second edition. University of California Press: Davis, CA.

Moyle, P. B., B. Herbold, D. E. Stevens, and L. W. Miller. 1992. Life History and Status of Delta Smelt in the Sacramento-San Joaquin Estuary, California. *Transactions of the American Fisheries Society* 121: 67–77.

Moyle, P. B., R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. *Fish Species of Special Concern of California*. California Department of Fish and Game. Rancho Cordova, CA.

Myrick, C. A. and J. J. Cech, Jr. 2001. *Temperature Effects on Chinook Salmon and Steelhead: A Review Focusing on California's Central Valley Populations*. White paper.

National Marine Fisheries Service. 2012. *Biological Opinion on the Continued Operation and Maintenance of Englebright Dam and Reservoir, Daguerre Point Dam, and Recreational Facilities on and Around Englebright Reservoir.* February 29. Southwest Regional Office. Long Beach, CA.

National Marine Fisheries Service. 2009. *Biological Opinion and Conference Opinion on the Long-Term Effects of the Central Valley Project and State Water Project*. June 4. Southwest Regional Office. Long Beach, CA.

National Marine Fisheries Service. 2008a. *Programmatic Consultation for Phase II of the Sacramento River Bank Protection Project*. Biological Opinion. July 2. Southwest Regional Office. Long Beach, CA.

National Marine Fisheries Service. 2008b. *Biological Report for the Proposed Designation of Critical Habitat for the Southern Distinct Population Segment of North American Green Sturgeon*. Draft. September 2008.

National Marine Fisheries Service. 2005. *Green Sturgeon (*Acipenser medirostris*) Status Review Updat*e. Biological review team, Santa Cruz Laboratory, Southwest Fisheries Science Center, California. February.

National Marine Fisheries Service. 2001. *Route 70 Upgrade Project Biological Opinion*. September. Sacramento, CA.

National Marine Fisheries Service. 1997. *Proposed Recovery Plan for the Sacramento River Winter-Run Chinook Salmon*. Southwest Regional Office. August. Available: <http://swr.nmfs.noaa.gov/hcd/recweb.htm> Accessed: July 21, 2009.

National Marine Fisheries Service. 1996a. *Factors for Decline: A supplement to the Notice of Determination for West Coast Steelhead under the Endangered Species Act*. NMFS Protected Species Branch, Portland, OR, and NMFS Protected Species Management Division, Long Beach, CA.

National Marine Fisheries Service. 1996b. *Recommendations for the Recovery of the Sacramento River Winter-Run Chinook Salmon*. Sacramento River Winter-run Chinook Salmon Recovery Team. National Marine Fisheries Service. Southwest Region.

Newman K. B. 2008. Sample Design-Based Methodology for Estimating Delta Smelt Abundance. *San Francisco Estuary and Watershed Science* 6(3): Article 3. Available: <http://repositories.cdlib.org/jmie/sfews/vol6/iss3/art3>.

Nobriega, M. and P. Cadrett. 2001. Differences Among Hatchery and Wild Steelhead: Evidence from Delta Fish Monitoring Programs. Interagency Ecological Program for the San Francisco Estuary, Sacramento, CA. *IEP Newsletter* 14(3): 30–38.

Nobriga, M. L., Z. Motica, and Z. P. Hymanson. 2004. Evaluating Entrainment Vulnerability to Agricultural Irrigation Diversions: A Comparison Among Open Water Fishes. *American Fisheries Society Symposium* 39: 281-295.

Nobriga, M, T. R. Sommer, F. Feyrer, K. Fleming. 2008. Long-Term Trends in Summertime Habitat Suitability for Delta Smelt (*Hypomesus transpacificus*). *San Francisco Estuary and Watershed Science* 6(1): Article 1.

Pacific Fishery Management Council. 2009. *Review of 2008 Ocean Salmon Fisheries*. Appendix B. Table B-1. February. Available: < http://www.pcouncil.org/salmon/stock-assessment-and-fishery-evaluation-safe-documents/review-of-2008-ocean-salmon-fisheries/> Accessed: July 22, 2009.

Pacific Fishery Management Council. 1999. *Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon*. Amendment 14 to the Pacific Coast Salmon Plan. August.

Raleigh, R. F., T. Hickman, R. C. Soloman, and P. C. Nelson. 1984. *Habitat Suitability Information: Rainbow Trout.* Biological Report 82 (10.60). U.S. Fish and Wildlife Service. Washington, D.C.

Reece, K. and T. Sommer. 2008. Yolo Bypass Study Highlights 2007-2008. *IEP Newsletter* 21(3): 10. Available: <http://www.water.ca.gov/iep/newsletters/2008/IEPNewsletterFinalSummer2008.pdf>. Accessed: July 28, 2009.

Reynolds, F. L., T. Mills, R. Benthin, and A. Low. 1993. *Central Valley Anadromous Fisheries and Associated Riparian and Wetlands Areas Protection and Restoration Action Plan*. Draft. California Department of Fish and Game, Inland Fisheries Division. Sacramento, CA.

Rich, A. A. 1987. *Report on Studies Conducted by Sacramento County to Determine Temperatures Which Optimize Growth and Survival in Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*)*. Prepared by McDonough, Holland, and Allen, Sacramento, CA.

Rosenfield, J. A., and R. D. Baxter. 2007. Population Dynamics and Distribution Patterns of Longfin Smelt in the San Francisco Estuary. *Transactions American Fisheries Society* 136: 1577–1592.

Snider, B., and R. G. Titus. 2000. *Timing, Composition, and Abundance of Juvenile Anadromous Salmonid Emigration in the Sacramento River near Knights Landing, October 1996—September 1997*. California Department of Fish and Game, Habitat Conservation Division. Stream Evaluation Program Technical Report No. 00-04.

Sommer, T, C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. 2007. The Collapse of Pelagic Fishes in the Upper San Francisco Estuary. *Fisheries* 32(6): 270–277.

Sommer, T., R. Baxter, and B. Herbold. 1997. Resilience of Splittail in the Sacramento-San Joaquin Estuary. *Transactions of the American Fisheries Society* 126: 961–976.

Sommer, T., K. Reece, and F. Mejia. 2009. Delta Smelt Life-History Contingents: A Possible Upstream Rearing Strategy? *IEP Newsletter* 22(1): 11–13.

Stevens, D. E. 1989. *When Do Winter-Run Chinook Salmon Smolts Migrate Through the Sacramento–San Joaquin Delta?* Memorandum. June 19. California Department of Fish and Game. Stockton, CA.

Stillwater Sciences. 2007. *Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II*. Final. October. Contract No. W91238-05-D-0009. Davis, CA. Prepared for U. S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

Swanson, C., and J. J. Cech. 1995. *Environmental Tolerances and Requirements of Delta Smelt,* Hypomesus transpacifus. Final Report. Department of Water Resources.

Sweetnam, D. A. 1999. Status of Delta Smelt in the Sacramento-San Joaquin Estuary. *California Fish and Game* 85: 22–27.

U.S. Army Corps of Engineers. 2014. *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures*. ETL 1110-2-583. April 30. Washington, D.C.

U. S. Army Corps of Engineers. 2007. *Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II*. Final. Contract No. W91238-05-D-0009. Prepared by Stillwater Sciences, Davis, CA, for the U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

U. S. Army Corps of Engineers, Sacramento District. 2006. Standard Assessment Methodology for the Sacramento River Bank Protection Project, SAM Users Manual – ECT Version 2.1, Final. Prepared by Stillwater Sciences and Dean Ryan Consultants, Sacramento CA. Contract DACW05-99-D-0006. Task Order 0017. February.

U.S. Army Corps of Engineers. 2004. *Standard Assessment Methodology for the Sacramento River Bank Protection Project*. Final report. Prepared by Stillwater Sciences, Davis, CA, and Dean Ryan Consultants & Designers, Sacramento, CA, for and in conjunction with U.S. Army Corps of Engineers and The Reclamation Board. Sacramento, CA.

U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, California Department of Water Resources, California Department of Fish and Game, and National Marine Fisheries Service. 2003. *Environmental Water Account EIS/EIR*. Draft. July 2003. Chapter 9, Fisheries and aquatic ecosystems/hydrologic modeling.

U.S. Fish and Wildlife Service. 2008. *Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP)*. Sacramento, CA.

U.S. Fish and Wildlife Service. 2001. *Restoration Plan for the Anadromous Fish Restoration Program—A Plan to Increase Natural Production of Anadromous Fish in the Central Valley of California*. Final Draft. January 9. Prepared for the Secretary of the Interior by the United States Fish and Wildlife Service with assistance from the Anadromous Fish Restoration Program Core Group under authority of the Central Valley Project Improvement Act. Available: <http://www.fws.gov/stockton/afrp/documents/finalrestplan.pdf>. Accessed: August 8, 2012.

U.S. Fish and Wildlife Service. 1996. *Sacramento-San Joaquin Delta Native Fishes Recovery Plan*. Portland, OR.

U.S. Fish and Wildlife Service. 1994. *Formal Consultation on the 1994 Operation of the Central Valley Project and State Water Project: Effects on Delta Smelt*. Portland, OR.

Wang, J. C. S. 1991. *Early Life Stages and Early Life History of the Delta Smelt,* Hypomesus transpacificus*, in the Sacramento-San Joaquin Estuary, with Comparison of Early Life Stages of the Longfin Smelt,* Spirinchus thaleichthys. Prepared for Interagency Ecological Program for the Sacramento-San Joaquin Estuary. Sacramento, CA.

Wang, J. C. S. 1986. *Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories*. FS/10-4ATR86-9. California Department of Water Resources. Sacramento, CA. Prepared for Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, Sacramento, CA.

Wang, J. C. S., and R. L. Brown. 1993. *Observations of Early Life Stages of Delta Smelt,* Hypomesus transpacificus*, in the Sacramento-San Joaquin Estuary in 1991, with a Review of its Ecological Status in 1988 to 1990*. Technical Report 35. November.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 1996. *Historical and Present Distribution of Chinook Salmon in the Central Valley Drainage of California*. Sierra Nevada Ecosystem Project: Final report to Congress, Vol. III—Assessments, Commissioned Reports, and Background Information. University of California, Centers for Water and Wildland Resources. Davis, CA.

Young, P. S., and J. Cech, Jr. 1996. Environmental Tolerances and Requirements of Splittail. *Transactions of the American Fisheries Society* 125: 664–678

Chapter 12: Wildlife

Baicich, P. J. and C. J. O. Harrison. 1997. *A Guide to the Nests, Eggs, and Nestlings of North American Birds*. 2nd edition. Academic Press: San Diego, CA.

Beedy, E. C. and W. J. Hamilton, III. 1999. Tricolored blackbird (*Agelaius tricolor*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/423>. Accessed: May 2009.

Brown, C. R. 1997. Purple martin (*Progne subis*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/287doi:10.2173/bna.287>. Accessed: May 2009.

Brown, P. E. and E. D. Pierson. 1996. *Natural History and Management of Bats in California and Nevada*. The Western Section of the Wildlife Society. November 13–15 workshop.

Butte County. 2010. *Butte County General Plan 2030*. Adopted October 26. Oroville, CA. Available: <http://www.buttegeneralplan.net/>. Accessed: June 28, 2012.

California Department of Fish and Game. 2012. *Burrowing Owl Mitigation.* Staff report. State of California Natural Resources Agency. March 7.Sacramento, CA.

California Department of Fish and Game. 2009. California Natural Diversity Database (CNDDB) Search for Butte, Colusa, Glenn, Placer, Sacramento, Yolo, Sutter, Solano, Yuba, and Tehama Counties. CNDDB RareFind 3, Version 3.1.0. Updated May 2, 2009. Sacramento, CA. Accessed: July 22, 2009.

California Department of Fish and Game. 2009. *Special Animals List*. The Natural Resources Agency, Department of Fish and Game Biogeographic Data Branch, California Natural Diversity Database. July.

California Department of Fish and Game. 2005. *California Wildlife Habitat Relationships*, version 8.1 personal computer program. California Interagency Wildlife Task Group. Sacramento, CA.

California Department of Fish and Game. 1994. *Mitigation for Impacts to Swainson's hawk (*Buteo swainsoni*) in the Central Valley of California*. Staff report. November 1. Sacramento, CA.

City of Sacramento, Sutter County, and Natomas Basin Conservancy. 2003. *Natomas Basin Habitat Conservation Plan*. Final. April. Sacramento, CA.

Colusa County. 2011. *Colusa County General Plan 2030*. Draft. November. Prepared by De Novo Planning Group. Sacramento, CA. Available: <http://countyofcolusageneralplan.org/sites/default/files/PublicReview_GP_Colusa_County_web.pdf>. Accessed: June 28, 2012.

Dunk, J. R. 1995. White-tailed Kite (*Elanus leucurus*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/178>. Accessed: May 2009.

England, A. S., M. J. Bechard, and C. S. Houston. 1997. Swainson's Hawk (*Buteo swainsoni*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithica, NY. Available: <http://bna.birds.cornell.edu/bna/species/265doi:10.2173/bna.265>. Accessed: May 2009.

Garrison, B. A. 1999. Bank Swallow (*Riparia riparia*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/414doi:10.2173/bna.414>. Accessed: May 2009.

Garrison, B. A. 1998. Bank Swallow (*Riparia riparia*). In: *The Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian-Associated Birds in California*. California Partners in Flight. Petaluma, CA.

Glenn County. 1993. *Glenn County General Plan*. Vol. 1—Policies. Adopted June 15. Planning and Public Works Agency. Willows, CA. Available: <http://www.gcplanupdate.net/_documents/docs/VOLUME%20I-POLICIES-1.pdf>. Accessed: June 28, 2012.

Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing Owl (*Athene cunicularia*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/061>. Accessed: May 2009.

Hughes, J. M. 1999. Yellow-Billed Cuckoo (*Coccyzus americanus*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/418doi:10.2173/bna.418>. Accessed: August 2009.

ICF International. 2012. Sacramento River Bank Protection Project, Erosion Management Report on Potential Impacts and Considerations for Bank Swallow and Associated Habitat. November. Prepared for the U.S. Army Corps of Engineers and the Central Valley Flood Protection Board, Sacramento, CA.

Jennings, M. R. and M.P. Hayes. 1994. *Amphibian and Reptile Species of Special Concern in California*. Final report. California Department of Fish and Game, Inland Fisheries Division. Rancho Cordova, CA.

Macwhirter, R. B. and K. L. Bildstein. 1996. Northern Harrier (*Circus cyaneus*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/210>. Accessed: May 2009.

Meese, R. 2006. *Settlement and Breeding Colony Characteristics of Tricolored Blackbirds in 2006 in the Central Valley*. Final report. Davis, CA. Prepared for the U.S. Fish and Wildlife Service and Audubon California.

Moffatt K. C., E. C. Crone, K. D. Holl, R. W. Schlorff, and B. A. Garrison. 2005. Importance of Hydrologic and Landscape Heterogeneity for Restoring Bank Swallow (*Riparia riparia*) Colonies along the Sacramento River, California. *Restoration Ecology* 13: 391–402.

Page, G. W., J. S. Warriner, J. C. Warriner, and P. W. Paton. 1995. Snowy Plover (*Charadrius alexandrinus*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/154doi:10.2173/bna.154>. Accessed: August 11, 2009.

Placer County. 1994. *Placer County General Plan Update*. Adopted August 16, 1994. Community Development Resource Agency. Auburn, CA. Available: <http://www.placer.ca.gov/Departments/CommunityDevelopment/Planning/Documents/CommPlans/PCGP.aspx>. Accessed: June 28, 2012.

Poole, A. F., R. O. Bierregaard and M. S. Martell. 2002. Osprey (*Pandion haliaetus*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/683doi:10.2173/bna.683>. Accessed: August 2009.

Sacramento County. 2011. *Sacramento County General Plan of 2005-2030*. Adopted November 9. Community Planning and Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/planning/Pages/GeneralPlan.aspx>. Accessed: July 11, 2012.

Sacramento County. 2008. *American River Parkway Plan*. Planning and Community Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/parks/Pages/ParkwayPlan.aspx >. Accessed: August 2009.

Solano County. 2008. *Solano County General Plan*. November. Department of Resource Management, Planning Services Division. Fairfield, CA. Available: <http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp>. Accessed: July 22, 2009.

Stillwater Sciences. 2007. *Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II (Final)*. October. Davis, CA. Contract No. W91238-05-D-0009. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

Sutter County. 2011. *Sutter County General Plan*. Adopted March 29. Yuba City, CA. Available: <http://www.co.sutter.ca.us/pdf/cs/ps/General_Plan_Policy_Document.pdf>. Accessed: June 28, 2012.

Sutter County. 2008. *General Plan Update Technical Background Report*. February. Yuba City, CA. Prepared by PBS&J. Available: <http://www.suttercounty.org/doc/government/depts/cs/ps/gp/gp_documents#background>. Accessed: August 2, 2012.

Swainson's Hawk Technical Advisory Committee. 2000. *Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley*. May 31.

Tehama County. 2009. *Tehama County General Plan*. March. Prepared by PMC. Chico, CA. Available: <http://www.tehamagp.com/documents/final_general_plan/Tehama%20County%20General%20Plan%20March%202009.pdf>. Accessed: June 28, 2012.

Twedt, D. J. and R. D. Crawford. 1995. *Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)—The Birds of North America Online* (A. Poole, Ed.). Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/192doi:10.2173/bna.192>. Accessed: May 2009.

U.S Army Corps of Engineers. 2009. *Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites, Sacramento River Bank Protection Project*. Prepared by North State Resources, Redding, CA, and Stillwater Sciences, Berkeley, CA. April.

U.S. Army Corps of Engineers. 2008. *Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009, Sacramento River Bank Protection Project, Sacramento River and Tributaries, California*. Final report. Prepared by Parus Consulting, Roseville, CA, and Ayres Associates, Sacramento, CA.

U.S. Army Corps of Engineers. 2006a. *Environmental Assessment/Initial Study for Five Critical Erosion Sites—River Miles 26.9 Left, 34.5 Right, 72.2 Right, 99.3 Right, and 123.5 Left, Sacramento River Bank Protection Project*. Final Report. Prepared by Stillwater Sciences, Davis, CA, and Ayres Associates, Sacramento. June 15.

U.S. Army Corps of Engineers. 2006b. *Environmental Assessment for Levee Repair of 14 Winter 2006 Critical Sites, Sacramento River Bank Protection Project*. Final Report. Prepared by Stillwater Sciences, Arcata, CA, and Ayres Associates, Sacramento, CA.

U.S. Fish and Wildlife Service. 2009. *List of Endangered and Threatened Species that May Occur in Butte, Colusa, Contra Costa, Glenn, Placer, Sacramento, Solano, Sutter, Tehama, Yolo, and Yuba Counties*. Last revised: January 29, 2009. Available: <http://www.fws.gov/sacramento/es/spp_list.htm>. Accessed: July 22, 2009.

U.S. Fish and Wildlife Service. 1999a. *Conservation Guidelines for the Valley Elderberry Longhorn Beetle*. July 9. Sacramento, CA.

U.S. Fish and Wildlife Service. 1999b. *Recovery Plan for the Giant Garter Snake (*Thamnopsis gigas*)*. Draft. Portland, OR.

U.S. Fish and Wildlife Service. 1997. *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California*. Sacramento, CA.

Yolo County. 2009. *Yolo County 2030 Countywide General Plan*. Adopted November 10. Planning and Public Works Department. Woodland, CA. Available: <http://www.yolocounty.org/Index.aspx?page=1965>. Accessed: July 11, 2012.

Yosef, Reuven. 1996. Loggerhead Shrike (*Lanius ludovicianus*). In: A. Poole (ed.), *The Birds of North America Online*. Cornell Lab of Ornithology. Ithaca, NY. Available: <http://bna.birds.cornell.edu/bna/species/231 doi:10.2173/bna.231>. Accessed: May 2009.

Yuba County. 2011. *Yuba County 2030 General Plan*. Adopted June 7. Community Development and Services Agency. Marysville, CA. Available: <http://www.yubavision2030.org/2030%20General%20Plan.aspx>. Accessed: June 28, 2012.

Yuba County. 2008. *Yuba County General Plan, General Plan Update Background Report*. January.

Zeiner, D. C., F. Laudenslayer, K. E. Mayer, and M. White. 1990a. *Birds*. Volume II of California Wildlife. California Department of Fish and Game. Sacramento, CA.

Zeiner, D. C., F. Laudenslayer, K. E. Mayer, and M. White. 1990b. *Mammals*. Volume III of California Wildlife. California Department of Fish and Game. Sacramento, CA.

Chapter 13: Land Use and Agriculture

California Department of Conservation 2007. *Williamson Act Program Reports and Statistics*. Division of Land Resource Protection. Available: <http://www.conservation.ca.gov/dlrp/lca/stats_reports/Pages/Index.aspx>. Accessed: August 2009.

California Department of Conservation. 2006. *Farmland Mapping & Monitoring Program—County PDF Maps*. Division of Land Resource Protection. Available: <http://www.conservation.ca.gov/dlrp/fmmp/Pages/Index.aspx>. Accessed: August 2009.

California Department of Food and Agriculture. 2009. *California Agricultural Resource Directory*. Sacramento, CA.

State of California. 2009. *The California Spatial Information Library: General Plans*. Available: <http://gis.ca.gov/casil/legacy.ca.gov/ Cadastre_Land_Related/GenPlans/>. Accessed: August 2009.

Chapter 14: Recreation

Butte County. 2010. *Butte County General Plan 2030*. Adopted October 26. Oroville, CA. Available: <http://www.buttegeneralplan.net/>. Accessed: July 12, 2012.

Colusa County. 2011. *Colusa County Draft General Plan 2030*. Prepared by De Novo Planning Group, Sacramento, CA. November. Available: < http://countyofcolusageneralplan.org/sites/default/files/PublicReview_GP_Colusa_County_web.pdf>. Accessed: July 12, 2012.

Glenn County. 1993. *Glenn County General Plan*. Vol. 1—Policies. Adopted June 15. Planning and Public Works Agency. Willows, CA. Available: <http://www.gcplanupdate.net/_documents/docs/VOLUME%20I-POLICIES-1.pdf>. Accessed: July 12, 2012.

Placer County. 1994. *Placer County General Plan Update*. Adopted August 16. Community Development Resource Agency. Auburn, CA. Available: <http://www.placer.ca.gov/Departments/CommunityDevelopment/Planning/Documents/CommPlans/PCGP.aspx>. Accessed: July 12, 2012.

Sacramento County. 2011. *Sacramento County General Plan of 2005-2030*. Adopted November 9. Community Planning and Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/planning/Pages/GeneralPlan.aspx>. Accessed: July 12, 2012.

Sacramento County. 2008. *American River Parkway Plan*. Planning and Community Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/parks/Pages/ParkwayPlan.aspx >. Accessed: August 2009.

Solano County. 2008. *Solano County General Plan*. November. Department of Resource Management, Planning Services Division. Fairfield, CA. Available: <http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp>. Accessed: July 12, 2012.

Sutter County. 2011. *Sutter County General Plan*. Adopted March 29. Yuba City, CA. Available: <http://www.co.sutter.ca.us/pdf/cs/ps/General_Plan_Policy_Document.pdf>. Accessed: July 12, 2012.

Tehama County. 2009. *Tehama County General Plan*. March. Prepared by PMC. Chico, CA. Available: <http://www.tehamagp.com/documents/final_general_plan/Tehama%20County%20General%20Plan%20March%202009.pdf>. Accessed: July 12, 2012.

Yolo County. 2009. *Yolo County 2030 Countywide General Plan*. Adopted November 10. Planning and Public Works Department. Woodland, CA. Available: <http://www.yolocounty.org/Index.aspx?page=1965>. Accessed: July 12, 2012.

Yuba County. 2011. *Yuba County 2030 General Plan*. Adopted June 7. Community Development and Services Agency. Marysville, CA. Available: <http://www.yubavision2030.org/2030%20General%20Plan.aspx>. Accessed: July 12, 2012.

Chapter 15: Population and Housing

U.S. Census Bureau. 2012. State and County QuickFacts. Data derived from Population Estimates, Census of Population and Housing, Small Area Income and Poverty Estimates, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits, Consolidated Federal Funds Report. Last Revised: January 31, 2012. Available: <http://quickfacts.census.gov/qfd/index.html>. Accessed: June 14, 2012.

Chapter 16: Utilities and Public Services

Butte County. 2010a. *Butte County General Plan 2030*. Adopted October 26. Oroville, CA. Available: <http://www.buttegeneralplan.net/>. Accessed: June 28, 2012.

Butte County. 2010b. *Butte County General Plan Draft EIR*. April 8. Available: <http://www.buttegeneralplan.net/products/2010-04-08_Draft_EIR/default.asp>.

Colusa County. 2010. *Colusa County General Plan Update Background Report*. Prepared by De Novo Planning Group. June. Sacramento, CA.

Glenn County. 1993. *Glenn County General Plan*. Adopted June 15. Planning and Public Works Agency. Willows, CA.

Placer County Water Agency. 2009. *Placer County Water Agency—Customer Service—Water Quality*. Available: <http://www.pcwa.net/level3/waterquality.html>. Accessed: August 17, 2009.

Sacramento County. 2009. *Water Supply Facilities Operations and Administrations*. Last revised: 2007. Available: <http://www.msa.saccounty.net/waterresources/wsfacilities.asp>. Accessed: August 18, 2009.

Sacramento County. 1993. *Sacramento County General Plan Background Report*. Municipal Services Agency, Planning and Community Development Department. Sacramento, CA.

Solano County. 2008. *Solano County General Plan*. November. Department of Resource Management, Planning Services Division, Fairfield, CA. Available: <http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp >. Accessed: July 22, 2009.

State Water Resources Control Board. 2007. *City of Yuba City: Wastewater Treatment Facility, Sutter County*. Last revised: October 25, 2007. Available:< http://www.swrcb.ca.gov/rwqcb5/board_decisions/tentative_orders/0710/yuba_city/yubacity_buff.pdf >. Accessed: August 17, 2009.

Sutter County. *2008. Sutter County General Plan Update Technical Background Report*. February. Yuba City, CA. Prepared by PBS&J.

Tehama County. 2009. *Tehama County General Plan*. March. Prepared by PMC. Chico, CA. Available: <http://www.tehamagp.com/>. Accessed: July 22, 2009.

Yolo County. 2009. *Yolo County 2030 Countywide General Plan*. Adopted November 10. Planning and Public Works Department. Woodland, CA. Available: ≤http://www.yolocounty.org/Index.aspx?page=1965>. Accessed: July 11, 2012.

Yuba County. 2009. *Yuba County General Plan Update Background Report*. Prepared by QUAD Consultants, Sacramento, CA, for Department of Planning and Building Services, Marysville, CA. Available: <http://www.co.yuba.ca.us/Departments/Community%20Development/Planning/Default%20Pages/yubacountygeneralplan.aspx>. Accessed: July 22, 2009.

Yuba-Sutter Disposal, Inc. 2009. Yuba-Sutter Disposal, Inc. website. Available: <http://www.ysdi.com/>. Accessed: August 31, 2009.

Chapter 17: Aesthetics

California Department of Transportation. 2009. *California Scenic Highway Program—Officially Designated State Scenic Highways.* Last revised: November 16, 2007. Available: <http://www.dot.ca.gov/hq/LandArch/scenic/schwy.htm>. Accessed: August 10, 2009.

California Department of Transportation. 2007. *Scenic Highway Guidelines.* Available: <http://www.dot.ca.gov/hq/LandArch/scenic/guidelines/scenic_hwy_guidelines.pdf>. Accessed: August 13, 2009.

Federal Highway Administration. 1988. *Visual Impact Assessment for Highway Projects.* FHWA-HI-88-054. U.S. Department of Transportation. Washington, DC.

Google Earth. 2009. Imagery dates May 2002–March 2008, from 40°02’58.21”N, 122°07’46.27”W to 30°04’36.46”N, 121°50’15.93”W. Accessed: August 10–14, 2009.

Google Maps. 2009. Available: <http://maps.google.com/maps?hl=en&rlz=1B3MOZA_enUS340US340&ie=UTF-8&tab=wlhttp://maps.google.com/maps?hl=en&rlz=1B3MOZA_enUS340US340&ie=UTF-8&tab=wl>. Accessed: August 10–14, 2009.

Jones, G. R., J. Jones, B. A. Gray, B. Parker, J. C. Coe, J. B. Burnham, and N. M. Geitner. 1975. A Method for the Quantification of Aesthetic Values for Environmental Decision Making. *Nuclear Technology* 25(4): 682–713.

Kleinfelder-Geomatrix. 2009. *Final Alternatives Report—80,000 LF (107 Sites), Sacramento River Bank Protection Project*. Contract No. W91238-08-D-0015. April 3. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

Sacramento County. 2008. *American River Parkway Plan*. Planning and Community Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/parks/Pages/ParkwayPlan.aspx>. Accessed: August 2009.

Stillwater Sciences. 2007. *Programmatic Biological Assessment for the Sacramento River Bank Protection Project, Phase II (Final)*. October. Davis, CA. Contract No. W91238-05-D-0009. Prepared for U. S. Army Corps of Engineers, Sacramento District, Sacramento CA.

U.S. Army Corps of Engineers. 2009. *Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites, Sacramento River Bank Protection Project*. Prepared by North State Resources, Redding, CA, and Stillwater Sciences, Berkeley, CA.

U.S. Bureau of Land Management. 1980. *Visual Resource Management Program*. Stock No. 024-001-00116-6. U.S. Government Printing Office. Washington, DC.

U.S. Fish and Wildlife Service. 2007. *Designating Rivers Through Section 2(a)(ii) of the Wild & Scenic Rivers Act*. Technical Report of the Interagency Wild and Scenic Rivers Coordinating Council. Revised June 2007. Richland, WA.

U.S. Forest Service. 1995. *Landscape Aesthetics: A Handbook for Scenery Management.* Agriculture Handbook Number 701.

U.S. Soil Conservation Service. 1978. *Procedure to Establish Priorities in Landscape Architecture*. Technical Release No. 65. Washington, DC.

Chapter 18: Public Health and Environmental Hazards

California Department of Toxic Substances Control. 2007. Envirostor database. Available: <http://www.envirostor.dtsc.ca.gov/public/>. Accessed: June 17, 2012.

Cleary, E. C., R. A. Dolbeer, and S. E. Wright. 2004. *Wildlife Strikes to Civil Aircraft in the United States, 1990–2003*. Federal Aviation Administration, National Wildlife Strike Database, Serial Report Number 10. Federal Aviation Administration, Office of Airport Safety and Standards. Washington D. C. Available: <http://wildlife.pr.erau.edu/Bash90-03.pdf>. Accessed: August 21, 2009.

Glenn County. 1993. *Glenn County General Plan*. Adopted June 15. Planning and Public Works Agency. Willows, CA.

Federal Aviation Administration. 2007. *Hazardous Wildlife Attractants on or Near Airports*. FAA Advisory Circular 150/5200-33B. Available: <http://www.faa.gov/airports/resources/advisory_circulars/media/150-5200-33B/150_5200_33b.pdf>. Accessed: August 21, 2009.

Federal Aviation Administration. 2014. *Wildlife Hazard Mitigation Program, Frequently Asked Questions and Answers*. Available: http://www.faa.gov/airports/airport_safety/wildlife/faq/. Accessed: June 26, 2014.

Sacramento County. 2008. *American River Parkway Plan.* Planning and Community Development Department. Sacramento, CA. Available: <http://www.msa2.saccounty.net/parks/Pages/ParkwayPlan.aspx >. Accessed: August 2009.

Sacramento County Airport System. 2009. *Sacramento International Airport Wildlife Hazard Management Plan*. Sacramento, CA

Sacramento International Airport. 2013. *Wildlife Hazard Management Plan.* March.

U.S. Army Corps of Engineers. 2009. *Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites, Sacramento River Bank Protection Project*. Draft. Prepared by North State Resources, Redding, CA, and Stillwater Sciences, Berkeley, CA.

U.S. Army Corps of Engineers. 2008. *Final Environmental Assessment/Initial Study for the Erosion Repairs of 13 Bank Protection Sites, 2008 and 2009, Sacramento River Bank Protection Project, Sacramento River and Tributaries, California*. Prepared by Parus Consulting, Roseville, CA, and Ayres Associates, Sacramento, CA.

U.S. Army Corps of Engineers. 2006a. *Environmental Assessment/Initial Study for Five Critical Erosion Sites—River Miles 26.9 Left, 34.5 Right, 72.2 Right, 99.3 Right, and 123.5 Left, Sacramento River Bank Protection Project*. Final Report. Prepared by Stillwater Sciences, Davis, CA, and Ayres Associates, Sacramento, CA. June 15.

U.S. Army Corps of Engineers. 2006b. *Environmental Assessment for Levee Repair of 14 Winter 2006 Critical Sites, Sacramento River Bank Protection Project*. Final Report. Prepared by Stillwater Sciences, Arcata, CA, and Ayres Associates, Sacramento, CA.

Chapter 19: Cultural Resources

Bennyhoff, J. A. and D. Fredrickson. 1994. A Proposed Integrative Taxonomic System for Central California Archaeology. In: Hughes, R. E. (ed.), *Toward a New Taxonomic Framework for Central California Archaeology: Essays by James A. Bennyhof and David A. Fredrickson*. Contributions of the University of California Archaeological Research Facility 52. Berkeley, CA.

Bouey, P. D. 1995 *Archaeological Analysis of CA-CAC-43, Cultural Resources Mitigation for the Sacramento Urban Area Levee Reconstruction Project, Sacramento County, California*. Final Report. FWARG, Davis, CA. Report on file, North Central Information Center, California State University, Sacramento. Sacramento, CA.

Elsasser, A. B. 1978. Development of Regional Prehistoric Cultures. In: R. F. Heizer (ed.), *California*. Volume 8—Handbook of North American Indians. W.C. Sturtevant, general editor. Smithsonian Institution: Washington, DC.

Fredrickson, D. A. 1974. Cultural Diversity in Early Central California: A View from the North Coast Ranges. *Journal of California Anthropology* 1(1): 41–53.

Fredrickson, D. A. 1973. *Early Cultures of the North Coast Ranges, California*. PhD. dissertation. University of California, Davis. Davis, CA.

Goldschmidt, W. 1951. Nomlaki Ethnography. *University of California Publications in American Archaeology and Ethnography* 42:4. University of California Press: Berkeley, CA.

Hartzell, L. L. 1992. *Hunter-Gatherer Adaptive Strategies and Lacustrine Environments in Buena Vista Lake Basin, Kern County, California*. Unpublished Ph.D. dissertation. Department of Anthropology, University of California, Davis. Davis, CA.

Hoover, M. B., H. E. Rensch, E. G. Rensch, and W. N. Abeloe. 1990. *Historic Spots in California*. 4th edition. Revised by D. E. Hoover et al. Stanford University Press: Palo Alto, CA.

Klimek, S. 1935. Culture Element Distributions, I: The Structure of California Indian Culture. *University of California Publications in American Archaeology and Ethnology* 37(1): 1–70.

Kroeber, A. L. 1939. Cultural and Natural Areas of Native North America. *University of California Publications in American Archaeology and Ethnology* 38.

Kroeber, A. L. 1936. Prospects in California Prehistory. *American Antiquity* 2: 108–116.

Moratto, M. J. 1984. *California Archaeology.* Academic Press: San Francisco, CA.

National Park Service. 2002. *How to Apply the National Register Criteria for Evaluation*. National Register Bulletin 15. On file at National Park Service, Washington DC.

Panamerican Consultants. 2010. *Cultural Resources Remote Sensing Survey and Diver Investigations at Selected Target Locations, Sacramento River Bank Protection Project, Sacramento River and Tributaries*. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

Rosenthal, J. S., G. G. White, and M. Q. Sutton. 2007. The Central Valley: A View from the Catbird's Seat. In:T. L. Jones and K. A. Klar (eds.), *California Prehistory: Colonization, Culture, and Complexity*. AltaMira Press: Lanham, MD.

Sacramento History Online. 2004. *Timeline*. Available: <http://www.sacramentohistory.org/resources_timeline.html>. Accessed: July 11, 2012.

Chapter 20: Socioeconomics and Environmental Justice

Council on Environmental Quality. 1997. *Environmental Justice under the National Environmental Policy Act, Guidance for Agencies on Key Terms in Executive Order 12898*. Appendix. December 10.

U.S. Census Bureau. 2012. *State and County QuickFacts*. Last revised: June 7, 2012. Available: <http://quickfacts.census.gov/qfd/index.html>. Accessed: July 2, 2012.

U.S. Environmental Protection Agency. 2009. *Environmental Justice*. Last revised: June 25, 2009. Available: <http://www.epa.gov/compliance/environmentaljustice/>. Accessed: August 24, 2009.

Chapter 21: Effects of Implementation in Economically-Justified Basins Only

None.

Chapter 22: Growth-Inducing and Cumulative Effects

Binns, N. A., and F. M. Eiserman. 1979. Quantification of Fluvial Trout Habitat in Wyoming. *Transactions of the American Fisheries Society* 108:215-228.

Bisson, P. A., R. E. Bilby, M. D. Bryant, C. A. Dolloff, G. B. Grete, R. A. House, M. L. Murphy, K. V. Koski, and J. R. Sedell. 1987. Large Woody Debris in Forested Streams in the Pacific Northwest: Past, Present, and Future. In: E. W. Salo and T. W. Cundy (eds.), *Streamside Management: Forestry and Fishery Interactions*. Institute of Forest Resources, University of Washington. Seattle, WA.

California Department of Fish and Game. 1983. *Sacramento River and Tributaries Bank Protection and Erosion Control Investigation: Evaluation of Impacts on Fisheries*. Final report. Bay-Delta Fishery Project.

California Department of Housing and Community Development. 2000. *Raising The Roof: California Housing Development Projections and Constraints, 1997–2020*. Statewide Housing Plan Update. Business Transportation and Housing Agency. May.

California Department of Water Resources. 2012. *2012 Central Valley Flood Protection Plan*. June. Sacramento, CA.

California Department of Water Resources, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 2013. *Environmental Impact Report / Environmental Impact Statement for the Bay Delta Conservation Plan*. Administrative Draft. May. Prepared by ICF International (ICF 00674.12), Sacramento, CA.

Harmon, M. E., J. F. Franklin, F. J. Swanson, P. Sollins, W. V. Gregory, J. D. Lattin, N. H. Anderson, S. P. Cline, N. G. Aumen, J. R. Sedell, G. W. Lienkaemper, K. Cromack Jr., and K. W. Cummins. 1986. Ecology of Coarse Woody Debris in Temperate Ecosystems. *Advances in Ecological Research* 15:133–302.

HDR. 2013. *Interim Draft Post Authorization Change Report for Sacramento River Bank Protection Project, California Phase II Supplemental Authorization*. Prepared for U.S. Army Corps of Engineers. April.

Hicks, B. J., J. D. Hall, P. A. Bisson, and J. R. Sedell. 1991. Responses of Salmonids to Habitat Changes. In: W. R. Meechan(ed.), *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats*. American Fisheries Society Special Publication 19.

ICF International. 2013. *Feather River West Levee Project 408 Permission Environmental Impact Statement*. Final. May. (ICF 00852.10.) Sacramento, CA. Prepared for U.S. Army Corp of Engineers, Sacramento, CA.

Lassettre, N. S., and R. R. Harris. 2001. *The Geomorphic and Ecological Influence of Large Woody Debris in Streams and Rivers*. University of California, Berkeley.

Nunnally, N. R., and R. B. Sotir. 1994. Soil Bioengineering for Streambank Protection. *Erosion* 1(5): 38–44.

Reeves, G. H., J. D. Hall, T. D. Roelofs, T. L. Hickman, and C. O. Baker. 1991. Rehabilitating and Modifying Stream Habitats. In: W. R. Meechan (ed.), *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats*. American Fisheries Society Special Publication 19.

Shields Jr., F. D., and J. J. Hoover. 1991. Effects of Channel Restabilization on Habitat Diversity, Twentymile Creek, Mississippi. *Regulated Rivers: Research and Management* 6: 163–181.

U.S. Army Corps of Engineers. 2013. *Baseline Accomplishments Report, Sacramento River Watershed, Sacramento River Bank Protection Project, Phase I & II Summaries.* Sacramento, CA.

U.S. Army Corps of Engineers. 2011. *Sea-Level Change Consideration for Civil Works Programs*. EC 1165-2-212.

Chapter 23: Indian Trust Assets

U.S. Geological Survey. 2012. Protected Areas Database of the United States, version 1.3, Combined Feature Class. Gap Analysis Program. November.

Chapter 24: Compliance with Applicable Laws, Policies, Plans, and Regulatory Framework

None.

Index

Page