United States Department of the Interior

BUREAU OF RECLAMATION
Mid-Pacific Region
South-Central California Area Office
1243 N Street
Fresno, CA 93721-1813

IN REPLY REFER TO:
SCC-423
ENV-7.00
Delta Division

DEC 21 2016

VIA ELECTRONIC MAIL AND U.S. MAIL

Ms. Maria Rea
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NOAA-National Marine Fisheries Service
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Sacramento, CA 95814
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Subject: Request for Initiation of Formal Consultation Pursuant to Section 7(a)(2) of the Endangered Species Act (16 U.S.C. § 1531 et seq.) regarding the Rock Slough Fish Screen Facilities Improvement Project

Dear Ms. Rea:

The purpose of this letter is to request initiation of formal consultation with NOAA-National Marine Fisheries Service (NMFS) pursuant to Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. §1531 *et seq*.). The Bureau of Reclamation (Reclamation) has determined that its' Proposed Action for the Rock Slough Fish Screen Facility Improvement Project (Project), in Contra Costa County, California, may affect ESA-listed species. A similar request for consultation is being sent to the U.S. Fish and Wildlife Service (Service).

A species list (including ESA-listed species and critical habitat) for consultation was generated through the Information for Planning and Conservation website (https://ecos.fws.gov/ipac/). Information available in Reclamation's files also was considered. The species list was last updated on December 19, 2016 with input from the Service, Document# 08FBDT00-2017-SLI-0052.

Reclamation has enclosed a Biological Assessment which evaluates the direct and indirect effects and any interrelated or interdependent effects from the Project on ESA-listed species and critical habitat. Where it has been determined that take would occur, a request for incidental take coverage is requested.

An analysis of the effects of the Project on Essential Fish Habitat (EFH) is included and Reclamation respectfully requests EFH consultation under the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §1855(b)).

If you have any questions regarding this request, please contact Dr. Ned Gruenhagen, Wildlife Biologist, at 559-487-5227, NGruenhagen@usbr.gov, or at 800-877-8339 for the hearing impaired.

Sincerely,

Rain L. Emerson
Supervisory, Natural Resources Specialist

Enclosure

cc: Mr. Bruce Oppenheim
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(w/ enclosure)

RECLAMATION
Managing Water in the West

Biological Assessment

Contra Costa Water District
Rock Slough Fish Screen Facility Improvement Project

11-061

U.S. Department of the Interior
Bureau of Reclamation

December 2016

Mission Statements

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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List of Acronyms and Abbreviations

AF	Acre-foot
ATV	All-terrain Vehicle
BA	Biological Assessment
BiOp	Biological Opinion
Canal	Contra Costa Canal
CCWD	Contra Costa Water District
CDBW	California Division of Boating and Waterways
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CNDDB	California Natural Diversity Data Base
CT	Critical Thermal Limits
cu ft	Cubic Feet
CVP	Central Valley Project
CVPIA	Central Valley Improvement Project Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CY	Cubic Yard
DO	Dissolved Oxygen
DPS	Distinct Population Segment
DWR	California Department of Water Resources
EC50	Concentration of a compound where 50% of its maximal effect is observed
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FL	Fork Length
FMC	Fishery Management Council
FMP	Fishery Management Plan

fps	Feet Per Second
GGS	Giant Garter Snake
HAPC	Habitat Areas of Particular Concern
hp	Horsepower
ITP	Incidental Take Permit
IPMP	Integrated Pest Management Program
kV	Kilovolt
LC50/LD50	The lethal concentration where 50% of the test population of an organism die in a specified period of time
LTO	Long-Term Operations
LSZ	Low Salinity Zone
mg/L	Milligrams per liter
MPA	Memorandum of Agreement
mps	Meters Per Second
MSDS	Material Safety Data Sheet
MHW	Mean High Water
MSA	Magnuson-Stevens Fishery Conservation and Management Act of 1976
NEPA	National Environmental Policy Act
NGDV	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NWP	Nationwide Permit
OCAP	Long-term Operational Criteria and Plan
O&M	Operations and Maintenance
PCE	Primary Constituent Element
PFMC	Pacific Fishery Management Council
PG&E	Pacific Gas and Electric
PP1	Pumping Plant 1
ppm	Parts per million
ppb	Parts per billion
ppt	Parts per thousand
Project	Rock Slough Fish Screen Facility Improvement Project
RBDD	Red Bluff Diversion Dam
Reclamation	Bureau of Reclamation
RPA	Reasonable and Prudent Alternative
RSFS	Rock Slough Fish Screen
RSL	CDEC Rock Slough Station
SCADA	Supervisory Control and Data Acquisition
SCCAO	South Central California Area Office
SFA	Sustainable Fisheries Act
SL	Standard Length
SWP	State Water Project
TL	Total Length
TNBC	The Natomas Basin Conservancy
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

WAPA	Western Area Power Administration

Section 1 Introduction

The purpose of this Biological Assessment (BA) is to review the proposed Rock Slough Fish Screen (RSFS) Facility Improvement Project (hereafter to referred to as the "Project") in sufficient detail to determine to what extent the Proposed Action may affect any Federally threatened, endangered, proposed threatened or endangered species, and designated or proposed critical habitat. In addition, the following information is provided to comply with statutory requirements to use the best scientific and commercial data available when assessing the risks posed to listed and/or proposed species and designated and/or proposed critical habitat. This BA is prepared in accordance with legal requirements set forth under Section 7 of the Endangered Species Act (ESA) (16 U.S.C. §1531 et. seq.) and the implementing regulations (50 CFR 402).

The Project contains the following main components: (1) improvements to the RSFS as well as various site improvements/adjustments; (2) administrative actions such as the transfer of Operation and Maintenance (O&M) from the Bureau of Reclamation (Reclamation) to Contra Costa Water District (CCWD), land acquisition, and/or the issuance of land use authorizations; and (3) O&M of the RSFS and associated appurtenances.

Transfer of the RSFS O&M to CCWD would ensure the O&M of this facility as required as a condition of Biological Opinions (BiOps) for the Los Vaqueros Project (USFWS 1993, NMFS 1993) and operation of the Central Valley Project (CVP) (USFWS 2008, NMFS 2009a). Operation of the facility is essential for delivery of water supplies to CCWD for municipal, industrial, and agricultural purposes.

The National Oceanic and Atmospheric Administration-National Marine Fisheries Service (NMFS) issued a letter on August 20, 2009 to Reclamation concurring that the construction of RSFS was not likely to adversely affect listed anadromous species or their critical habitat. The letter described the background to the concurrence for the project, noting that the 1993 NMFS Los Vaqueros BiOp Project was a non-jeopardy opinion for Sacramento River winter-run Chinook salmon. It further noted that as new fish species were listed, incidental take coverage for CCWD's diversions (including Rock Slough) was included in the BiOp for the long-term operations of the CVP and State Water Project (SWP) BiOp released by NMFS in 2000, 2001, 2002, 2004, and most recently on June 4, 2009. NMFS, in a letter dated August 20, 2009, indicated that the proposed project (construction of the fish screen) would eliminate the annual incidental take of ESA listed species due to effects of pumping from Rock Slough, as described in previous NMFS and U.S. Fish and Wildlife Service (USFWS) BiOps (USFWS 2008, NMFS 2009a). The operational effects of diversion (including pumping from Pumping Plant 1) by CCWD are covered in the NMFS and USFWS BiOps for the long-term operations (LTO) of the CVP and SWP (NMFS 2009a, USFWS 2008), hereafter referred to as the LTO BiOps; however, RSFS rake operations and O&M activities of the facilities, and any effects from land actions that may result in take have not been addressed. Reclamation is therefore seeking coverage for effects from O&M activities of the RSFS Facility, beyond what is covered in the LTO BiOps for effects from diversion of water through the facilities.

1.1 Project Overview

Construction on the RSFS by Reclamation began in 2009 in order to comply with requirements of the Central Valley Improvement Project Act (CVPIA) and the Los Vaqueros BiOp issued by USFWS in 1993. According to the Los Vaqueros BiOp (USFWS 1993), the purpose of the RSFS Facility is to provide protection to the federally threatened delta smelt (*Hypomesus transpacificus*), threatened spring-run Chinook salmon (*Onchorhynchus tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), endangered winter-run Chinook salmon (*O. tshawytscha*), and the threatened North American green sturgeon (*Acipenser medirostris*) and State-listed longfin smelt (*Spirinchus thaleichthys*)[1] from being entrained by CCWD's water diversions, while allowing diversions to serve CCWD's water users. Major construction work at the RSFS was deemed substantially complete; however, mechanical, safety, and operational issues with the facility remain unresolved. Consequently, the RSFS is not considered fully operational.

Since construction of the RSFS, the four rakes designed to brush the screens and pick up debris have not operated reliably, have experienced breakdowns, and have captured fish, including listed species. In addition, heavy debris loading has impacted operation of the rakes, and dense aquatic vegetation beyond the reach of the rakes has resulted in the inability of maintenance personnel to access the screen. Breakdowns of the rakes have been frequent and at times have resulted in the release of hydraulic fluid into Rock Slough. The inability to clean the screen as intended in order to avoid buildup of material has impacted the ability to maintain design approach velocities of water and to prevent potentially damaging differential pressure across the screen. All of these issues have impacted the operations of the RSFS, could impact CCWD's ability to reliably use the Rock Slough intake for its water supply, and could jeopardize operations.

The proposed RSFS improvements are designed to address mechanical failures, hydraulic fluid releases, excessive maintenance, and other deficiencies and to allow RSFS to be operated more safely, effectively, and efficiently.

1.2 Background

CCWD conducts maintenance activities upstream of the RSFS, along the unlined portion of the Contra Costa Canal (Canal) in the vicinity of the RSFS Facility, and in the surrounding area. Much of the land within the RSFS Facility boundary is paved and a chain link fence with barbed wire surrounds the alarmed facility. A locked gate at Cypress Road prevents unauthorized vehicles access. Maintenance activities may occur on both banks of the Canal, within the Canal, and in the rights-of-way from Cypress Road to the RSFS.

The four rakes at the RSFS, each intended to clean approximately 25% of the screen (eight bays each), have yet to operate reliably. Since August 2011, a larger than expected amount of aquatic weeds including Brazilian elodea (*Egeria densa*), water hyacinth (*Eichhornia crassipes*),

[1]USFWS determined that while longfin smelt warrant listing, the listing is impeded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants. USFWS will develop a proposed rule to list longfin smelt as their priorities allow (USFWS 2012).

coontail (*Ceratophyllum demersum*), and water primrose (*Ludwigia peploides*) have surrounded the screen on both faces and covered the log booms and navigational lights. Given these conditions, the following unanticipated issues have arisen:

- A number of fall-run Chinook salmon were entrapped in the rakes during performance testing of the four fish screen rakes in 2011 and 2012[2].
- Rake system aquatic weed removal has been more difficult than anticipated due to the volume and weight of the weeds and has been further complicated by mechanical failures.
- Hydraulic fluid was released into Rock Slough during mechanical rake failure.
- Insufficient area on existing platforms has restricted safe human access needed to repair the rakes when they have failed mid-screen.
- Insufficient access to the water has restricted CCWD's ability to implement routine inspection of the fish screen and in-water components as well as respond to failures and deploy booms when there was an accidental release of fluids.
- Excessive loading of vegetation and buildup of aquatic weeds upstream of the screen and out of reach of the rakes (Note: Currently there are no boat ramps to allow water access upstream and downstream of the fish screen).
- Although the fish screen rakes were not operated when salmonids were present, in November 2015, a fall-run Chinook salmon was entrapped within the rake system.
- CCWD was unable to install the repositioned Rock Slough log boom until June 2016 (primarily due to landowner issues). By May 2016 a buildup of aquatic weeds resulted in a large screen differential and a relief panel was lifted to protect the integrity of the facility (Note: The large mat of aquatic weeds at the face of the screen were too great for the rakes to manage and mechanical vegetation harvesting was conducted and completed by mid-June 2016).

The now repositioned log boom is expected to reduce the number of aquatic weeds that drift into the RSFS, improve future maintenance such as mechanical harvesting in front of the RSFS, and is needed in the near term to allow installation of a block net in order to test the rakes from November through April when listed salmonids may be present.

CCWD plans to commence testing of the new prototype rake as soon as October 2016. Testing will likely continue through the end of 2016 and during the beginning of 2017, but may extend longer due to the iterative design, installation and testing process required to acquire a functional design for final installation.

1.3 Species Analyzed in this Biological Assessment

This BA analyzes the following species regulated by NMFS:

1. Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit (ESU)

[2] Note: The 2011 and 2012 performance testing operation of the rakes is not expected to be representative of typical operations.

2. Central Valley spring-run Chinook salmon ESU,
3. Central Valley steelhead Distinct Population Segment (DPS), and
4. Southern DPS of the North American green sturgeon.

This BA analyzes the following species and critical habitat regulated by the USFWS, where applicable:

1. Delta smelt and its critical habitat,
2. Giant garter snake *Thamnophis gigas*, and
3. Longfin smelt[3].

A list of ESA-listed species regulated by the USFWS that could be found near the vicinity of the Project was generated on February 16, 2016 by accessing the Information for Planning and Conservation website (https://ecos.fws.gov/ipac/). The list was updated on September 15, 2016, and no additional species were added to the list. Each of the listed species was analyzed to determine if it could be affected by activities of the Project. The list of species, information regarding their habitat, the potential for effects, and the justification for the determination that the Project would not affect these species is provided in Table 1.

Table 1 ESA-listed Species Regulated by the USFWS not Analyzed Further

Common Name	Scientific Name	ESA Status	Habitats of Occurrence	Effect / No Effect	Justification
Amphibians					
California Red-legged Frog	*Rana draytonii*	Threatened	Lowlands and foothills in or near permanent deep water with dense, shrubby or emergent riparian habitat. Requires 11 to 20 weeks of permanent water for breeding and larval development. Must have access to aestivation habitat.	No Effect	No dense riparian habitat near the project site. Abundant bullfrogs and predatory fishes. Surveys around Project site have found no evidence of this species.
California Tiger Salamander	*Ambystoma californiense*	Threatened	Vernal pools, swales and depressions for breeding, needs underground refugia.	No Effect	Nearest known occurrence is over 6 miles from site. Surveys around Project site have not found evidence of this species.
Crustaceans					
Conservancy Fairy Shrimp	*Branchinecta conservatio*	Endangered	Endemic to the grasslands of the northern two-thirds of the Central Valley in turbid pools.	No Effect	No vernal pools will be disturbed by project activities.

[3] USFWS determined that while longfin smelt warrant listing, the listing is impeded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants. USFWS will develop a proposed rule to list longfin smelt as their priorities allow (USFWS 2012).

Common Name	Scientific Name	ESA Status	Habitats of Occurrence	Effect / No Effect	Justification
Vernal Pool Fairy Shrimp	*Branchinecta lynchi*	Threatened	Endemic to the grasslands of the Central Valley, Central Coast mountains, and South Coast mountains, in astatic rain-filled pools. Inhabits small, clear-water sandstone-depression pools and grassed swale, earth slump, or basalt-flow depression pools.	No Effect	No vernal pools will be disturbed by project activities.
Vernal Pool Tadpole Shrimp	*Lepidurus packardi*	Threatened	Turbid vernal pools and swales in Sacramento Valley. Grass bottomed swales of unplowed grasslands.	No Effect	No vernal pools will be disturbed by project activities.
Flowering Plants					
Antioch Dunes Evening-primrose	*Oenothera deltoids* ssp. *howellii*	Endangered	Sand dune habitat.	No Effect	No sand dune habitat near the project site.
Insects					
San Bruno Elfin Butterfly	*Callophrys mossii bayensis*	Endangered	Coastal, mountainous areas with grassy ground cover, mainly in the vicinity of San Bruno Mountain, San Mateo County. Colonies are located on steep, north-facing slopes within the fog belt; larval host plant is Sedum *spathulifolium*.	No Effect	No larval host plant present within Action area.
Valley Elderberry Longhorn Beetle	*Desmocerus californicus dimorphus*	Endangered	Found in association with blue elderberry (*Sambucus mexicana*) only in the riparian forests of the Central Valley of California from Shasta County to Kern County.	No Effect	No larval host plant present with Action area.
Mammals					
San Joaquin Kit Fox	*Vulpes macrotis mutica*	Endangered	Annual grasslands or grassy stages with scattered shrubby vegetation. Needs friable soils for burrowing.	No Effect	Last known closest observation of SJKF in the vicinity was in the foothills of the Diablo Range in 1975.
Reptiles					
Alameda Whipsnake	*Mastocophis lateralis euryxanthus*	Threatened	Valley-foothill hardwood habitat of the coast ranges between Monterey and north San Francisco Bay areas. Inhabits south-facing slopes and ravines where shrubs form a vegetative mosaic with oak trees and grasses.	No Effect	Wrong region and habitat type.

1.4 Consultation History

USFWS Biological Opinion on the Los Vaqueros Reservoir Project

USFWS issued a non-jeopardy BiOp (1-1-93-F-35) in 1993 on the effects to delta smelt from the proposed Los Vaqueros Reservoir Project. The BiOp required Reclamation to screen the Rock

Slough intake at the Canal by October 1998 in accordance with the CVPIA Section 3406(b)(5). The completion date was later extended to 2003, then to December 31, 2008. As mitigation in the most recent extension, it was required that Reclamation pay $50,000/year into the East Contra Costa County Habitat Conservation Plan until the construction of the screen by the set completion date of December 31, 2008. With passage of the America Recovery and Reinvestment Act of 2009 (PL. 111-5), funding became available for construction of the RSFS Project.

NMFS Biological Opinion on the Los Vaqueros Project

NMFS issued a non-jeopardy opinion on March 18, 1993, which covered incidental take for effects to Sacramento River winter-run Chinook salmon. Monitoring of incidental take at the Rock Slough, Mallard Slough, and Old River intakes is required by this BiOp.

NMFS Biological Opinion for the Operations Criteria and Plan

NMFS issued a non-jeopardy BiOp (151422SWR04SA9116: BFO), dated October 22, 2004, with regard to impacts of the proposed revised LTO of the CVP and SWP. The species and critical habitat addressed were: endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened Southern Oregon/Northern California Coast coho salmon (*O. kisutch*), threatened Central California Coast steelhead, and critical habitat for Sacramento River winter-run Chinook salmon and Southern Oregon/Northern California Coast coho salmon. Incidental take coverage provided for the Rock Slough intake by this BiOp is five juvenile Sacramento River winter-run Chinook salmon, 10 juvenile Central Valley spring-run Chinook salmon, and five total (adults and juveniles) Central Valley steelhead, annually. This BiOp requires continuation of incidental take monitoring at the Rock Slough intake.

NMFS determined that the LTO of the CVP and SWP would adversely affect Essential Fish Habitat (EFH) for starry flounder (*Platichthys stellatus*) and Pacific salmon (*Oncorhynchus* spp.) and made conservation recommendations. One conservation recommendation (cessation of pumping from Rock Slough when Chinook salmon are detected near the intake) was aimed at reducing entrainment of fall/late fall-run Chinook salmon at the Rock Slough intake until such time it was screened.

NMFS concurrence letter dated June 23, 2006

Concurrence letter from NMFS to Reclamation regarding implementation of the Canal Replacement Project (151422SWR2004SA9129:BFO).

Informal Consultation on the Canal Aquatic Vegetation Management Program

Reclamation sent a letter to NMFS on March 19, 2007 requesting concurrence under Section 7 of the ESA and Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) for CCWD's Aquatic Vegetation Management Program for July through October 2007.

Meetings were held with USFWS and NMFS on July 16, 2007, August 31, 2007, December 17, 2007, and January 10, 2008 to review CCWD's Komeen™ applications in July and September 2007 as well as proposed plans for Aquatic Weed Control in 2008 and beyond. Reports and other documents on the application of aquatic herbicides, documented listed fish presence, the CCWD Aquatic Vegetation Program, and other documents were provided to USFWS and NMFS.

NMFS concurrence letter dated May 17, 2007

Concurrence letter from NMFS to Reclamation permitting use of Komeen™ within the unlined Canal from July through October 2007.

NMFS concurrence letter dated June 11, 2007

Concurrence letter from NMFS to Reclamation confirming a previous concurrence letter regarding implementation of the Canal Replacement Project (151422SWR2004SA9129:BFO).

USFWS Biological Opinion on the Canal Replacement Project

USFWS issued a BiOp on June 21, 2007, which addressed effects on delta smelt and its critical habitat, California red-legged frog (*Rana draytonii*), California tiger salamander (*Ambystoma californiense*), giant garter snake, and San Joaquin kit fox (*Vulpes macrotis mutica*) from CCWD's Canal Replacement Project.

NMFS Biological Opinion on the LTO of the CVP and SWP

On June 4, 2009, NMFS issued the BiOp for the LTO of the CVP and the SWP (NMFS 2009a).

NMFS concurrence letter dated August 20, 2009

Letter from NMFS to Reclamation concurring with Reclamation's determinations that the Proposed Action for the fish screen installation and some limited maintenance may affect, but is not likely to adversely affect, endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened Central Valley steelhead, threatened southern DPS of North American green sturgeon, designated and proposed Critical Habitat for the above species, and EFH for Pacific Salmon. This letter concluded that the amount of incidental take associated with the operation of the Rock Slough diversion had been considered in previous Los Vaqueros Project and LTO BiOps; therefore, it did not represent any new or additional take.

USFWS letter dated September 3, 2009

USFWS reviewed the effects of the proposed Canal Fish Screen Project on delta smelt and its critical habitat and on giant garter snake. USFWS concluded that the proposed construction of the fish screen was not going to result in any effects beyond those previously considered in USFWS's earlier documents. The letter went on to say that the operations of the Rock Slough intake were covered in USFWS's *2008 Formal Endangered Species Act Consultation of the Proposed Coordinated Operations of the CVP and SWP*. The 2008 BiOp considered the effects of the unscreened Rock Slough diversions and quantified incidental take associated with all CCWD diversions as all delta smelt inhabiting the water diverted in the assumed 195 thousand acre feet maximum diversion amount described in the BiOp's project description. The letter also stated, "Since the Rock Slough diversion will now be screened, less entrainment will be expected than what was described in the 2008 biological opinion and the expected incidental take remains the same."

Reclamation letter dated October 28, 2010

Reclamation requested an amendment to NMFS' 1993 Los Vaqueros Reservoir Project BiOp (NMFS 1993) to bring it up to date and coordinate operations of CCWD's four diversions in the Delta with the operations of the CVP and SWP contained in the LTO BiOps (USFWS 2008, NMFS 2009a). CCWD is the applicant for the project.

Informal Consultation on the RSFS Facility Improvement Project

Informal consultation between Reclamation and NMFS on Reclamation's current Proposed Action has occurred through teleconferences and exchanges of e-mail between April 2011 and February 2012. Additionally, CCWD representatives, the proposed Operating Entity for O&M of the RSFS Facility, have also participated in the teleconferences and have engaged NMFS with questions concerning consultation on the project. A site visit to the facility in July 2011 was attended by representatives from Reclamation, NMFS, and CCWD.

NMFS letter dated September 1, 2011

NMFS sent an insufficiency letter responding to Reclamation's October 28, 2010 letter requesting amendment to NMFS 1993 Los Vaqueros Reservoir Project BiOp. NMFS recommended that O&M for CCWD's four screened diversions (Old River, Rock Slough, Middle River, and Mallard Slough) be consolidated into one Section 7 consultation, to include such things as maintenance and cleaning of the fish screens, aquatic weed control, periodic desilting (dredging), and other O&M activities. The new BiOp would cover incidental take for such things as cleaning, maintenance, and removal of silt in front of CCWD's diversions that were not addressed in the NMFS 2009 LTO BiOp.

May 29, 2015 Site Visit at the RSFS Facility

The meeting was attended by USFWS, NMFS, CCWD, Reclamation, and Tenera Environmental, Inc. (Tenera). The purpose of the meeting was to discuss the RSFS Facility Improvement Project and to observe operation of the RSFS rakes.

January 2015 Conference Call

A conference call was held with Reclamation, CCWD, NMFS, and USFWS to discuss testing and modifications of the RSFS.

Prototype Rake Testing at the RSFS

In November 2015, Reclamation approved an extension for testing the prototype rake due to schedule delays. The authorization by Reclamation to continue the testing plan included consultation with NMFS and confirmation of ongoing take coverage for listed salmonids. USFWS concurrence letter dated November 9, 2015. Reclamation received a concurrence letter from USFWS to conduct mechanical harvesting upstream of the RSFS in November 2015.

Emergency Mechanical Harvesting at the RSFS

On May 19, 2016, Reclamation requested emergency ESA consultation with the USFWS and NMFS for mechanical harvesting (no ground disturbance) of aquatic weeds at the RSFS since the "significant buildup of nuisance invasive non-native aquatic plants & debris (e.g. hyacinth, Brazilian elodea, etc.) upstream and in front of the RSFS has precluded the proper operation of the RSFS and has further compromised and posed failure threats to the structure & equipment at the RSFS as well as downstream". On May 20, 2016, USFWS provided their acknowledgement of the emergency consultation and requested that the measures provided in the draft Categorical Exclusion Checklist prepared for the action be implemented. On May 26, 2016, NMFS provided their acknowledgment of the emergency consultation and requested that CCWD monitor removed vegetation for listed fish species.

1.5 Relationship of the Proposed Action to Other Reclamation Actions

Coordinated Long-Term Operation of the CVP and SWP

The effects of CVP and SWP pumping on federally listed fishes and their critical habitat have been addressed by BiOps issued to Reclamation for the Coordinated LTO of the CVP and SWP (NMFS 2009, USFWS 2008). The BiOp issued by the USFWS to Reclamation for the Coordinated LTO of the CVP and SWP found that operations as proposed were likely to jeopardize the continued existence of delta smelt and adversely modify its critical habitat. The USFWS provided a Reasonable and Prudent Alternative (RPA) with five components. On December 15, 2008, Reclamation submitted a memo provisionally accepting the RPA. The memo also indicated that Reclamation would immediately begin implementing the RPA. The provisional acceptance of the RPA was conditioned upon the further development and evaluation of the two RPA components directed at aquatic habitats. Reclamation stated that the two RPA components, RPA Component 3 – the fall action, and RPA Component 4 – the tidal habitat restoration action, both need additional review and refinement before Reclamation would be able to determine whether implementation of these actions by the CVP and SWP is reasonable and prudent.

The BiOp issued by NMFS determined that long term SWP and CVP operations were likely to jeopardize several species and result in adverse modification of their critical habitat. NMFS also developed an RPA and included it in the BiOp. On June 4, 2009, Reclamation sent a provisional acceptance letter to NMFS, citing the need to further evaluate and develop many of the longer-term actions, but also stating that Reclamation would immediately begin implementing the near-term elements of the RPA.

Reclamation also consulted under the MSA with NMFS on the impacts to EFH for Chinook salmon as a result of the pumping (NMFS 2009).

However, following their provisional acceptance, both BiOps were subsequently challenged in Court, and following lengthy proceedings, the United States District Court for the Eastern District of California remanded the BiOps, and Reclamation was ordered by the Court to comply with the National Environmental Policy Act (NEPA) before accepting the RPAs. In March and December 2014, the BiOps issued by the USFWS and NMFS, respectively, were upheld by the Ninth Circuit Court of Appeals, although certain requirements (such as an obligation for Reclamation to follow a NEPA process) were left in place. Reclamation completed NEPA on the LTO BiOps and issued a Record of Decision on January 11, 2016. Since then, Reclamation has re-initiated consultation on the LTO.

Biological Opinion on the Los Vaqueros Project

Reclamation received BiOps from USFWS and NMFS in 1993 for consultations on the Los Vaqueros Project. The USFWS BiOp covered delta smelt and required CCWD's Canal intake on Rock Slough to be screened, in compliance with the CVPIA (Section 3406(b)(5)). NMFS BiOp was a non-jeopardy opinion, and provided take coverage for winter-run Chinook salmon. Additionally, monitoring of incidental take at the Rock Slough, Mallard Slough, and Old River intakes is required. As a consequence of the Los Vaqueros Project, the RSFS was constructed and consultation on the O&M and various land actions of this facility is being addressed in this BA.

Biological Opinion on the Operations and Maintenance Program on Reclamation Lands within the South-Central California Area Office Jurisdiction

Reclamation consulted with the USFWS for O&M activities occurring on Reclamation lands under the jurisdiction of the South-Central California Area Office. The USFWS issued a BiOp (1-1-04-F-0368) on February 17, 2005. The opinion considers the effects of routine O&M of Reclamation's facilities used to deliver water to the study area, as well as certain other facilities within the jurisdiction of the South-Central California Area Office, on California tiger salamander, vernal pool fairy shrimp, valley elderberry longhorn beetle, blunt-nosed leopard lizard, vernal pool tadpole shrimp, San Joaquin wooly-threads, California red-legged frog, giant garter snake, San Joaquin kit fox, and on proposed critical habitat for the California red-legged frog and California tiger salamander.

1.6 Structure of the Biological Assessment

This BA contains the following eight Sections and two appendices:

Section 1 – Introduction
Section 2 – Description of the Proposed Action
Section 3 – Status of the Species and Critical Habitat in the Action Area
Section 4 – Environmental Baseline
Section 5 – Effects of the Action
Section 6 – Cumulative Effects
Section 7 – Literature Cited
Section 8 – List of Contributors and Reviewers

Appendix A – EFH Assessment
Appendix B – CCWD's Integrated Pest Management Program (IPMP).

Section 2 Description of the Proposed Action

2.1 Project Location

The RSFS Facility is located at the junction of Reclamation's unlined Canal and Rock Slough, approximately four miles southeast of the City of Oakley, California (Figure 1). A detailed description of the Action Area for the Proposed Action is included in Section 2.3.

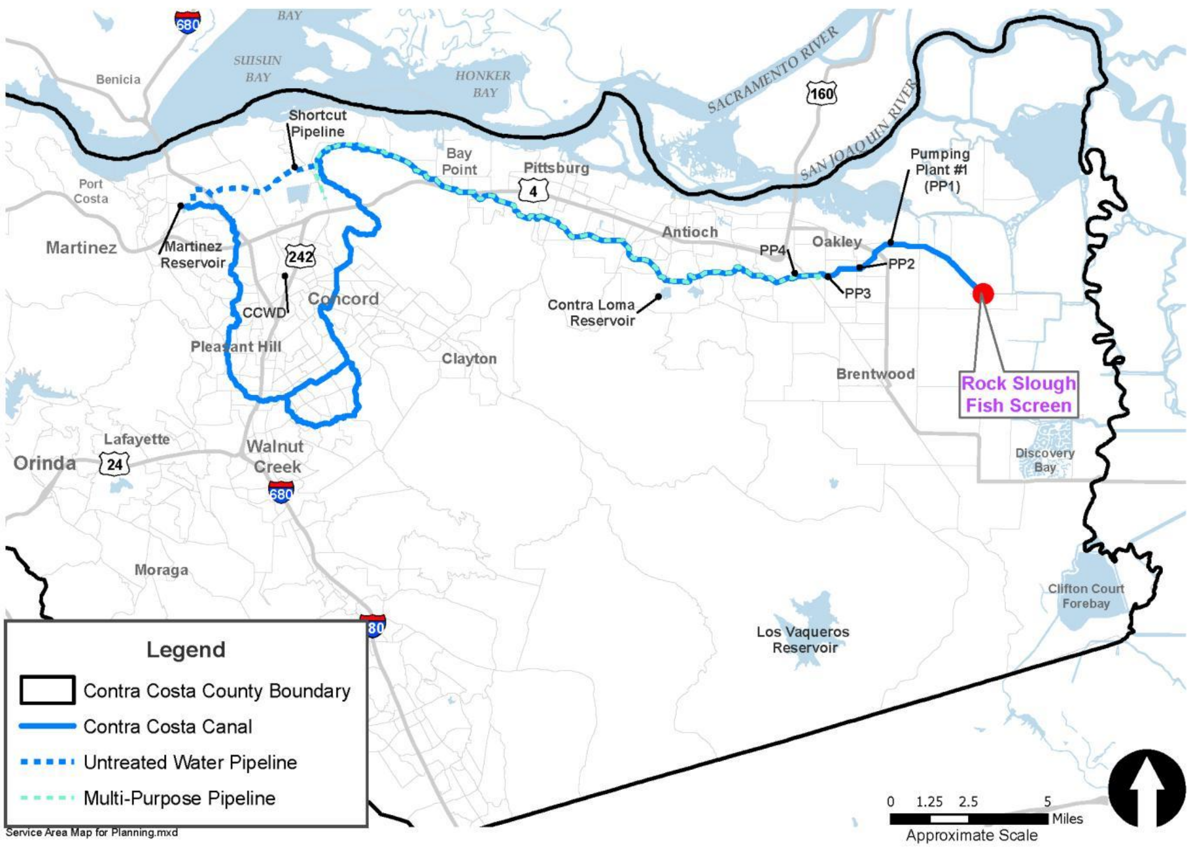

Figure 1 RSFS Facility Vicinity Map

2.2 Project Summary

The Project will make improvements to the existing RSFS Facility (Figure 2) as well as various site improvements/adjustments. The Project will also modify and continue O&M of the RSFS and associated appurtenances. A summary of proposed activities for the Project is provided in Table 2 and shown in Figure 2. Specific details for each action are described more fully in their respective sections below.

Table 2 Summary of Reclamation actions for the RSFS Improvement Project

Action	Type of Activity/Duration
Physical design and modification improvements including: mechanical rake and debris handling system; extension of rake motor access platform; construction of boat ramps in front and behind the RSFS; adjustment of fencing, berms, culverts, drainage ditches; property restoration; movement of fill material; and irrigation system improvements.	Rake design, installation and evaluation is iterative until functional design is achieved. Final construction, one time.
RSFS Facility ongoing maintenance activities associated with: land areas; water areas in front and behind screen; and screen structure and mechanical features including rakes and debris and hydraulic systems.	Ongoing, as required each year.
Ongoing operation of the rakes and debris handling system.	Daily screen brushing to ensure 2/32-inch wedge wire screen does not plug with debris. Use rakes to pick up debris in front of screen as required.

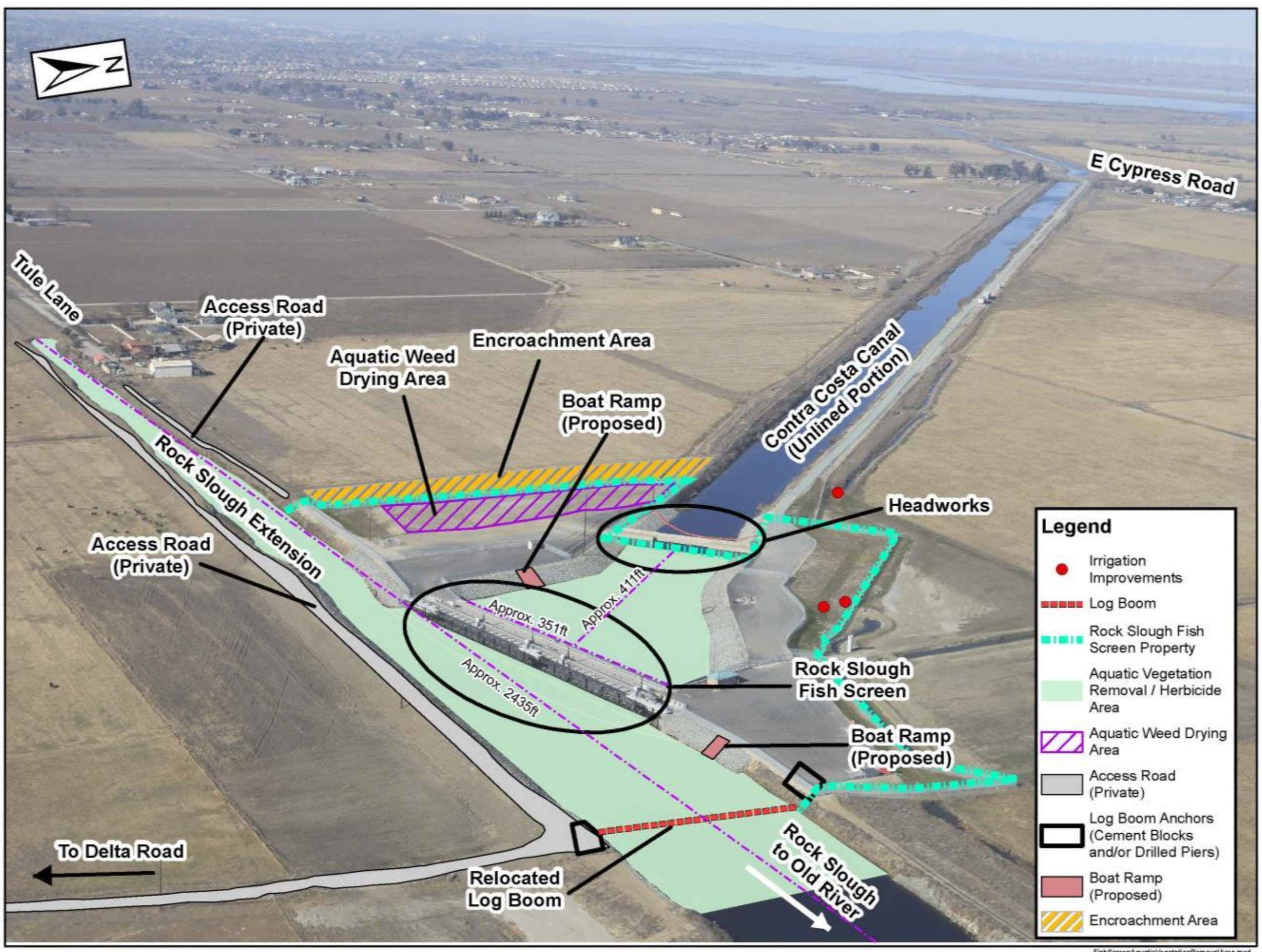

Figure 2 RSFS Facility Improvement Project Action Area

2.2.1 Rock Slough Fish Screen Facility Improvements

A summary of the RSFS Facility improvements, site access, equipment to be used, irrigation system improvements, and land encroachment repairs are provided below.

Rake Improvements

To ensure that screen approach velocities are uniform across the entire screen and do not exceed USFWS design conditions of 0.2 feet per second for protection of listed fish, CCWD would replace the existing rakes (see Figure 3) with new automated hydraulic rakes/heads, including four rakes/heads that will empty onto the debris conveyance system. The rake repairs include the following modifications: 1) replacement of the rake head with a re-designed head (see Figure 4) that will more effectively capture and remove debris, and clean the screen; 2) installation of hydraulic seal containment/cooling/alarm systems to return fluid to the hydraulic reservoir in the event of a hydraulic cylinder seal failure; and 3) re-programming of the rake head to provide multiple cleaning modes that will improve cleaning and enable testing of various debris removal and brush-only cycles. Although these modifications are anticipated to correct deficiencies in the current facilities, subsequent, iterative modifications may be required to achieve functional operation meeting the intended goals set for the facility. Improvement of the rakes will not require any in-water work within Rock Slough.

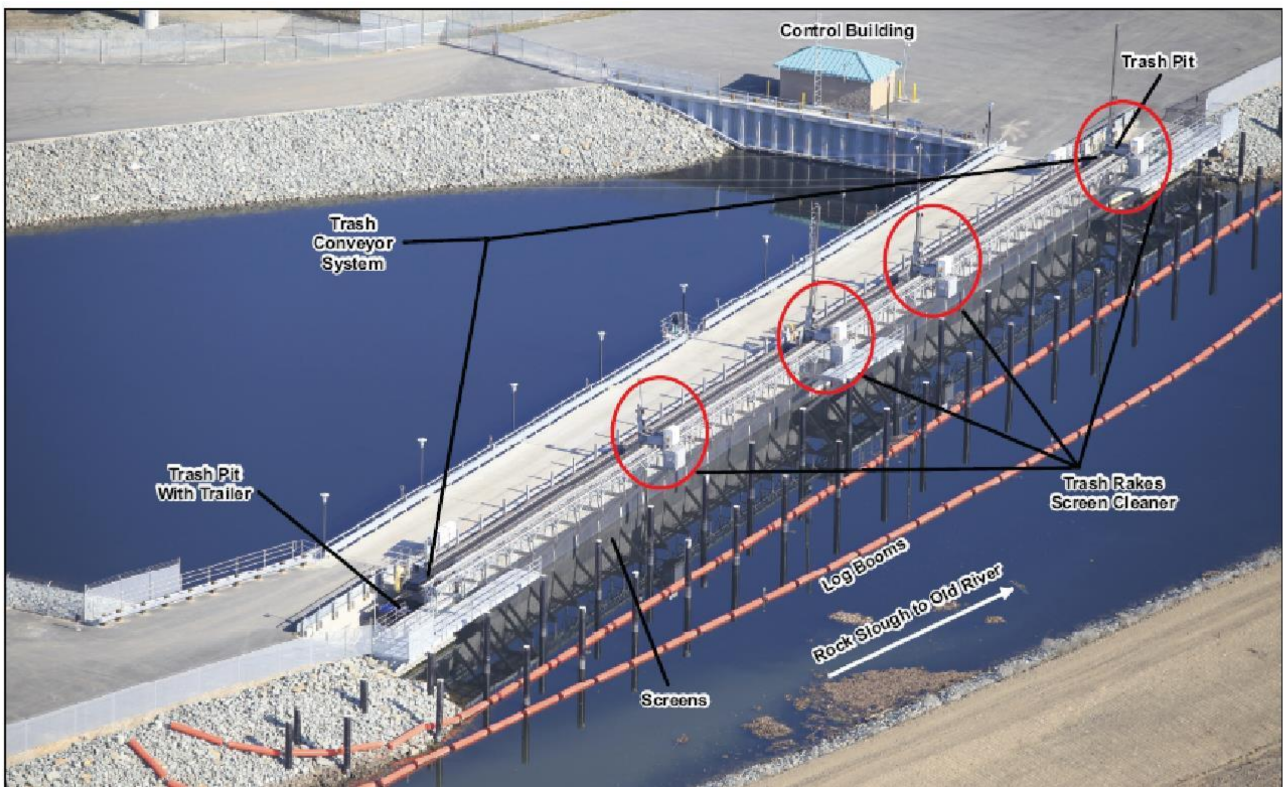

Figure 3 The Existing RSFS Facility (trash racks are circled in red)

The rake heads will be fabricated off-site and installed at the RSFS. Installation will involve manual labor, movement of heavy loads with a crane or boom truck, and the use of hand tools. Installation of the new rakes is not anticipated to require more than three months.

Figure 4 Prototype Rake Installed in 2015 at Rake Number 2

Debris Conveyance System Improvements

The existing concrete debris pits will be modified so that small tractors can be used to safely remove debris and carry debris to the drying area at the site. Improvements would consist of filling in an open concrete area under the conveyor belt where it discharges into the existing pit. The open area under the conveyor is concrete and will be filled using gravel, the fill will be covered with concrete, and a bulkhead wall will be installed at the base of the conveyor belt where it discharges into the pit. The area to be filled is approximately 8 feet long, 5 feet in height, and approximately 12 feet wide. The bulkhead wall within the smaller debris pit will allow small tractors to pick up the debris that could build up in the open area under the conveyor belt that was otherwise not reachable with equipment. Improvements to the debris conveyance system will be completed in approximately two months.

Platform Extension

The existing platform system (which is segmented in three pieces, one on each shore, and a third in the middle to span across the full length of the screen) will be extended outward, away from the screens face, to provide safe access to the rake system for maintenance in the event the rakes either stop operation or they need to be serviced at locations other than where the existing platforms currently provide access. Figure 5 shows the existing safety deck on the northeast side of the RSFS. The open grated platform extensions will be fabricated off-site and installed at the RSFS. The work will be accomplished with hand tools and welding equipment. Movement of heavy loads will be accomplished with a crane or boom truck. It is anticipated that it will require approximately two months to complete construction of the platform extensions. Installation of the platform extensions will not require any in-water work within Rock Slough.

Figure 5 Existing Safety Deck on the Northeast side of the RSFS

Boat Ramp Construction

CCWD will install two boat ramps (upstream and downstream of the RSFS) from July 1 through October 31; this time period includes both in-water work and land work. The ramps will provide access for inspection and maintenance of the in-water components of the RSFS. The boat ramps will also be used to launch vessels to deploy booms if there is an accidental release of fluids, to launch vessels for mechanical harvesting or application of aquatic herbicides, or for other procedures where water access may be needed. Photographs of the location of the proposed downstream ramp (west boat launch) and upstream ramp (east boat launch) are shown in Figures 6 and 7. A silt curtain will be installed prior to in-water work in order to minimize the amount of turbidity during construction.

The sites for the two boat ramps will be prepared by removing overlying rip rap and excavating into existing soils of levee banks to create ramps down to elevation minus 4 feet mean sea level (elevation referenced to NGDV 29). The site plan and the profile and section views of the boat ramps are shown in Figures 8 and 9, respectively.

Figure 6 Proposed Location for the Downstream Boat Ramp

Figure 7 Proposed Location for the Upstream Boat Ramp

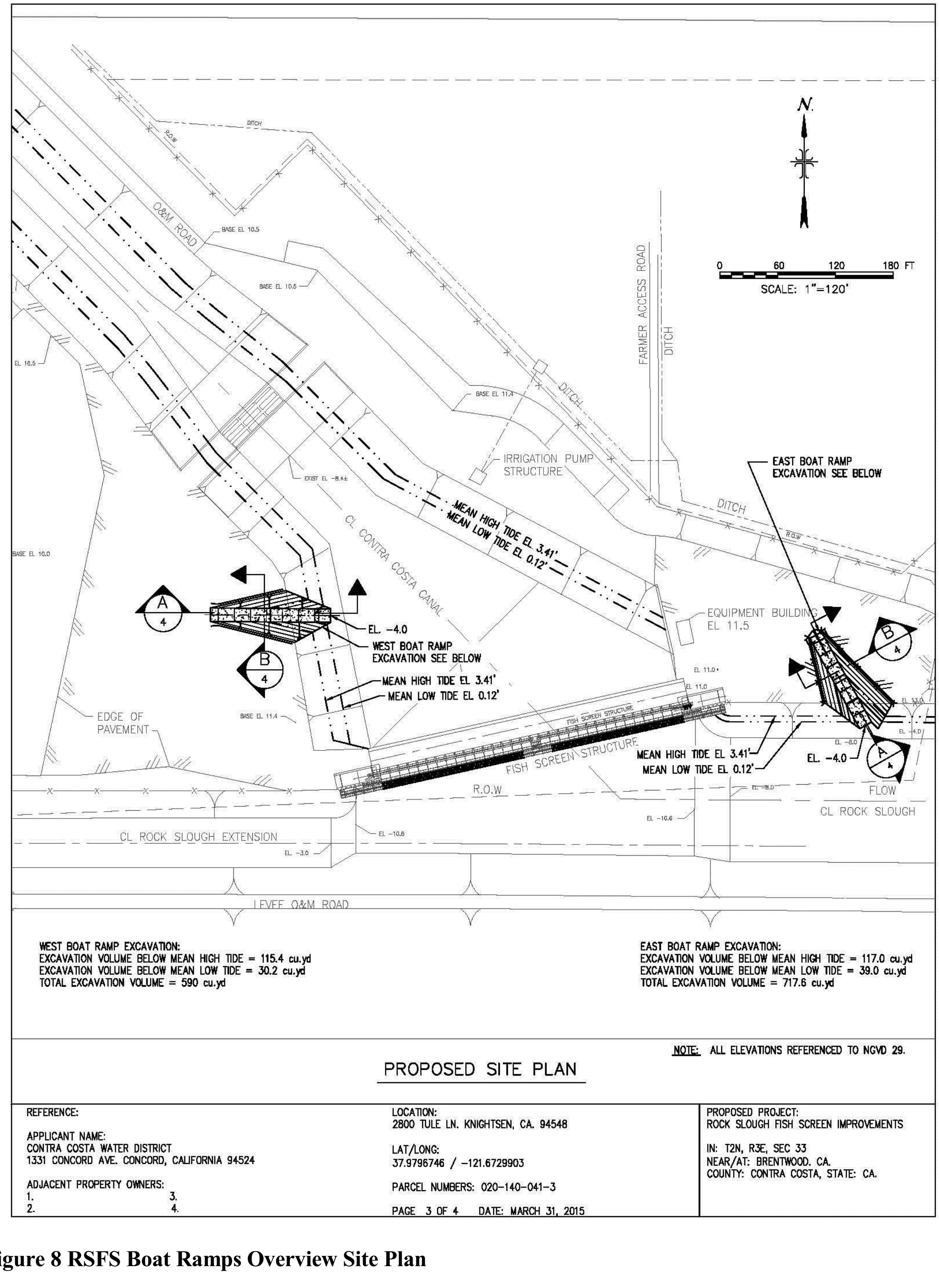

Figure 8 RSFS Boat Ramps Overview Site Plan

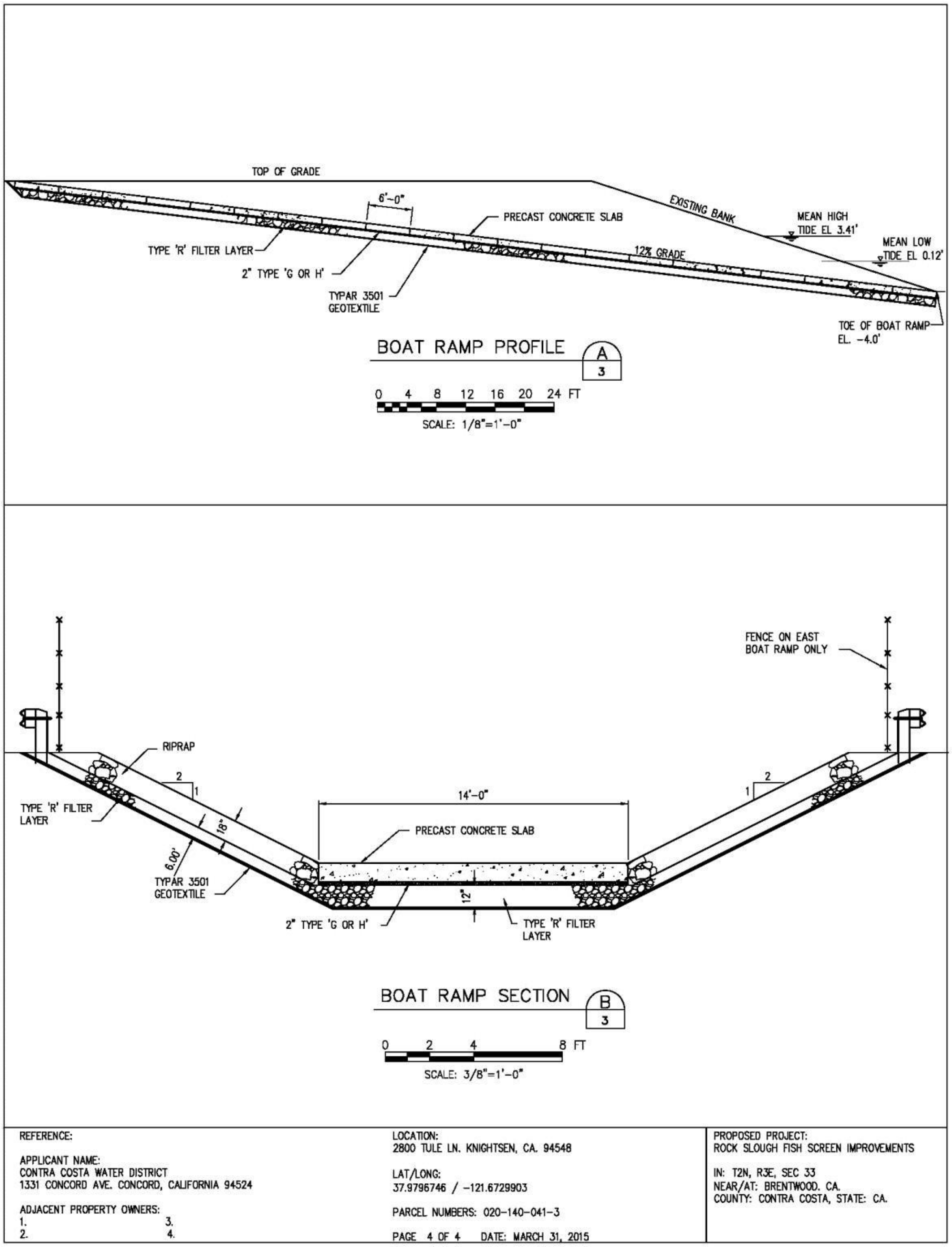

Figure 9 RSFS Boat Ramps Profile and Section Views

The west boat ramp (located in the afterbay, downstream of the RSFS) excavation volume below mean high tide is 115.4 cubic yards (CY), 30.2 CY below mean low tide, and total excavation volume is 590 CY. The east boat ramp (located in Rock Slough, upstream of the RSFS) excavation volume below mean high tide is 117.0 CY, 39.0 CY below mean low tide, and total excavation volume is 717.6 CY. The ramp surfaces will be precast reinforced concrete of an interlocking design that allows for settling and requires no concrete casting in or near the water.

Construction of the boat ramps will involve cutting and removal of pavement, excavation of soils with conventional earth moving equipment, and a workboat. Construction is anticipated to require an excavator, wheeled front-end loader, and dump trucks for hauling excess material off-site for disposal. A workboat will be required for placement of silt curtains. Excavation will be followed by compaction of the subgrade using a plate or roller compactor. A layer of drain rock will be placed beneath the side slope rip rap and boat ramp precast concrete; this material will be placed with a combination of an excavator, front-end loader, and hand raking. Rip rap on the side slopes will be placed with an excavator and by some hand work. The precast sections of concrete may be placed using an excavator, front-end loader, fork lift, or mobile crane depending upon the type of equipment the contractor has on-site.

Dewatering to construct the boat ramps will not be required. The material placement will be accomplished during low tide periods and only the boom of an excavator will enter the water. Before the use of any vehicles or equipment on-site, the vehicles and equipment will be thoroughly cleaned and inspected for fuel and oil leaks, and Reclamation's decontamination procedures (Reclamation 2012a) will be followed. No leaking vehicles or equipment will be allowed on-site at any time. The portion of Rock Slough and the Canal where the boat ramps are to be constructed will be contained within a floating silt curtain (described below). Construction of each boat ramp is not expected to require more than 75 days to complete.

The boat ramp located in Rock Slough will result in a permanent loss of approximately 1,400 square feet (0.02 acre) of benthic habitat to the mean high tide level in Rock Slough and approximately 1,400 square feet (0.02 acre) of benthic habitat to the mean high tide level in the RSFS afterbay. The 0.04 acres is also jurisdictional wetlands and CCWD will be requesting a nationwide 404 permit from the U.S. Army Corps of Engineers as well as a 401 permit from the Regional Water Quality Control Board. In addition, a Rivers and Harbors Act permit will be required.

Log Boom Placement

Upon completion of the RSFS in 2011, two log booms were installed parallel to the intake screen (see Figure 3). Both of the log booms were anchored into the rip rap within Reclamation right of way. The log boom placement allowed open navigation past the RSFS to the end of the Rock Slough Extension. However, the placement of the two log booms was not effective at reducing the amount of aquatic weeds contacting the screen. Weeds became trapped in between the two log booms and hindered maintenance of aquatic weeds in front of the RSFS. The Rock Slough Extension also became choked with heavy aquatic weeds that drifted in to this location from the Delta. Between 2011 and November 2015 the water area in front of the screen and in the Rock Slough Extension was engulfed with a diverse assortment of aquatic weeds. The weeds became so problematic that the RSFS rakes were no longer capable of handling the heavy and dense mat of weeds that had formed in front of the screen.

In November 2015, after receiving concurrence from the U.S. Coast Guard, CCWD removed one of the log booms in order to conduct mechanical harvesting of the aquatic weeds. In June 2016, CCWD relocated the remaining log boom approximately 600 feet upstream of the RSFS using ecology blocks[4] as anchors (see Figure 10 for location of the relocated log boom and Figure 11 for a photograph of the ecology blocks used to anchor the relocated log boom). The relocated log boom is positioned so that it spans the width (approximately 165 feet) of Rock Slough. The log boom in this location may be modified in the near future to include a gate so that the downstream property owners can enter and exit the area. CCWD is monitoring the performance of the temporary anchor blocks monthly to ensure that no shifting has occurred. If shifting occurs, CCWD will adjust the blocks and/or install additional anchor blocks. A flatbed truck, dump truck, and a backhoe would be used to move or place new blocks. Previous placement of the temporary anchors was completed within one week and it would be expected to require the same amount of time to move or place new anchors.

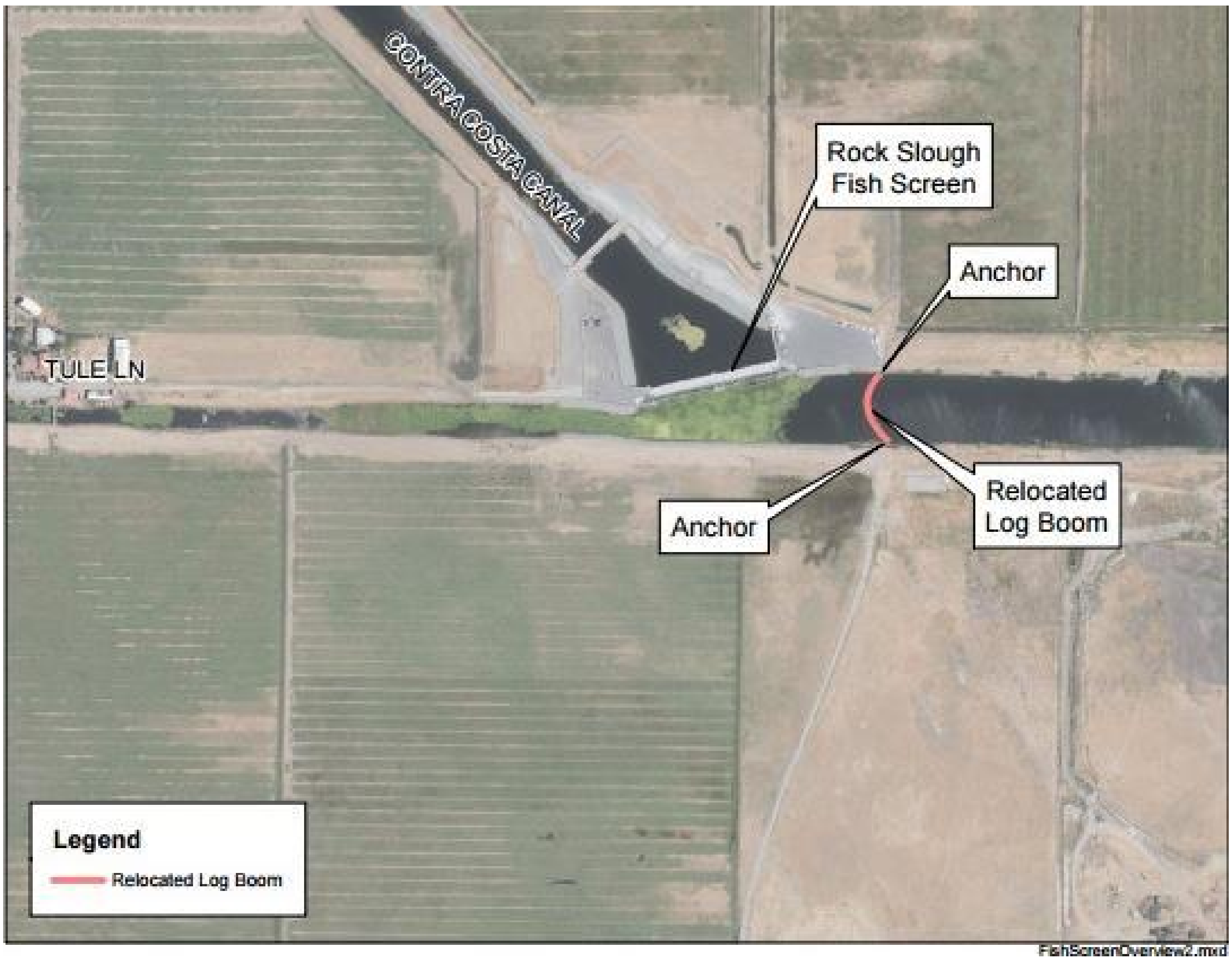

Figure 10 Location of the Relocated Log Boom

[4] Ecology blocks are dead weights that anchor the log boom. Each ecology block is 5 feet long, 2.5 feet wide, and 2.5 feet high. These blocks rely solely on dead-weight (approximately 4,500 pounds each) and frictional resistance to the ground surface to resist tension.

Figure 11 Photograph of the Ecology Block used to Anchor the Relocated Log Boom

It is possible that these temporary anchors may remain for up to five years or until such time as the proposed Rock Slough Bridge is constructed by Caltrans (this is a separate project unrelated to the RSFS Facility Project). Once the Rock Slough Bridge is constructed, the log boom will likely be relocated and anchored upstream of the bridge so that it is visible to boaters. At that time, CCWD will replace the temporary ecology blocks with more permanent pilings in order to anchor the log boom. The permanent log boom anchoring system will be installed in existing rip rap placed on the levee bank of the south side of Rock Slough and in an earthen sloped bank on the north side of Rock Slough. Construction of the pilings will take place above the mean high tide level within Rock Slough, on the stream side of the banks within Rock Slough. The piling anchors will require excavation to approximately 2 feet below ground surface to install a 6 foot by 6 foot concrete pad, 1 foot thick anchor pad, and a 2 foot diameter boring 7 feet below ground surface (see Figure 12). Approximately 94 CY of levee material, consisting of silty to clayey sand and fat clay will be removed for each anchor; however, approximately 36 CY will be placed back over the top of the 36 square feet anchor pad and the material will be compacted. Therefore, each anchor will permanently remove 58 CY of levee material for disposal off site. Where existing rip rap has been moved to facilitate construction of the anchors, the rip rap will be stored on site and moved back over the anchor pad after construction. Construction of the anchors may require access for a well drilling rig, concrete truck, small backhoe, and/or pickup trucks. It is anticipated that construction of the anchors will take up to four weeks to excavate, set forms, pour concrete, and to ensure that concrete has reached maximum strength prior to attaching the log boom to the anchors. The equipment for this work would be staged inside the fenced RSFS Facility, preferentially on paved areas.

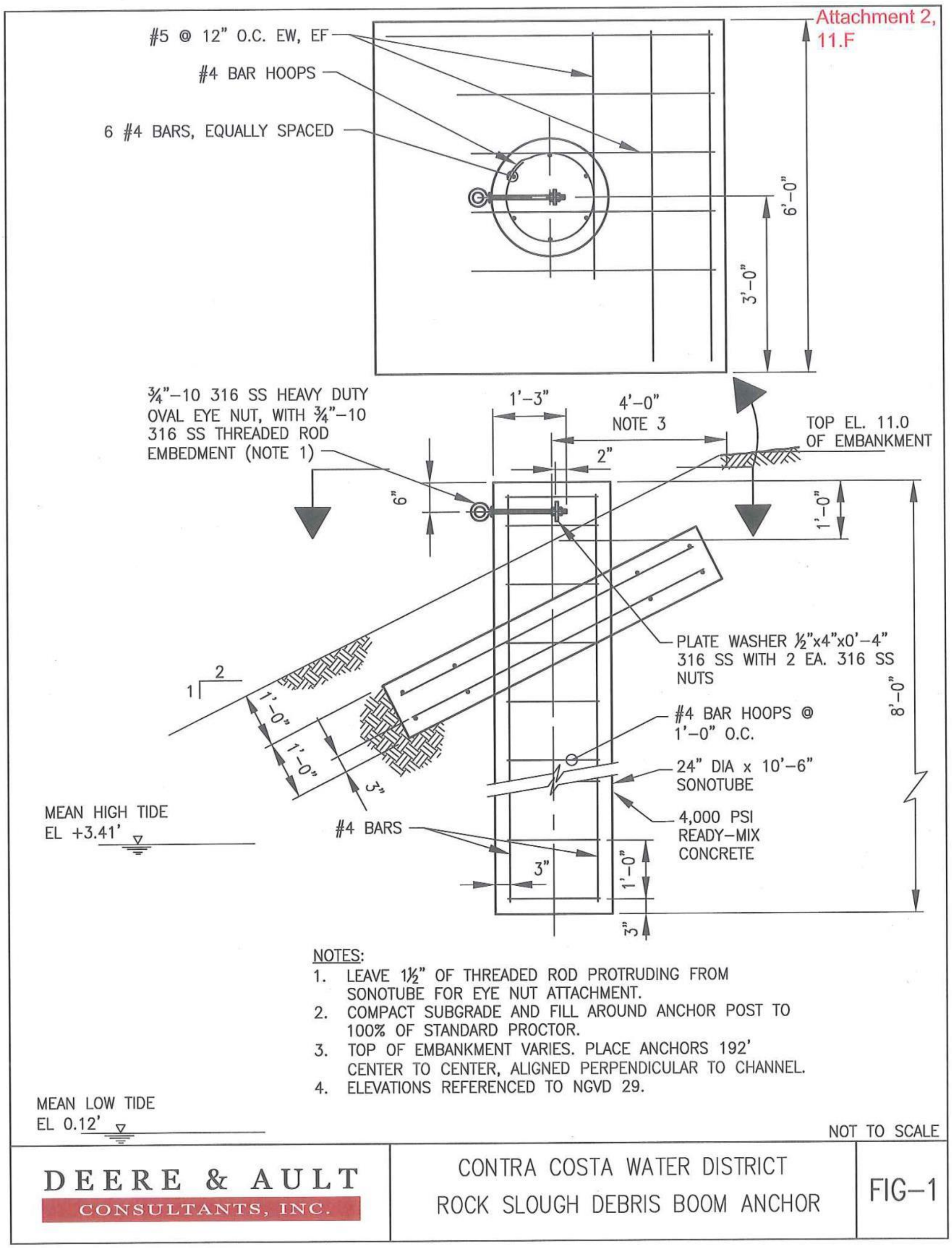

Figure 12 Engineering Detail for Proposed Piling Anchors for Relocated Log Boom

Installation or movement of the log boom will be accomplished using a boat for in-water portions of the work and a skid steer or boom truck for shore operations. Once the log boom has been relocated to the new anchors, CCWD will inspect and maintain the log boom and anchors up to two times per year, or additionally should unexpected events occur that could affect the boom or supports (e.g., large storm tides, earthquakes, etc.).

If the proposed new location for the log boom proves to be problematic, then CCWD will consider either removing the log boom completely and/or installing the pilings in the current location of the relocated log boom. Considerations for the eventual final placement of the log boom will include navigational safety, requirements to maintain a block net longer term, landowner permission to access the south side of Rock Slough, and maintenance activities associated with mechanical harvesting. CCWD expects that during the initial period of deployment it will gain a better understanding of the above considerations.

Irrigation System Improvements

When the RSFS was constructed it was necessary to relocate the adjacent ranchers' irrigation system that had been located upstream of the Canal. The ranchers' irrigation system was relocated downstream of the fish screen and created a benefit to fish by screening an otherwise unscreened intake. However since the irrigation system was relocated there have been numerous issues related to the pumps, freshwater irrigation intake, and irrigation valves.

Pump Replacement As part of the Proposed Action, two existing pumps will be replaced by the ranchers. The existing 40 horse power (hp) two-stage bowl assembly will be replaced with a 25 hp single bowl assembly. The existing 5 hp mixed-flow bowl assembly will be replaced with a 10 hp axial-flow bowl assembly.

Freshwater Irrigation Intake Improvements When the relief panel at the RSFS was lifted in May and June of 2016, the ranchers installed a chain link fence around the freshwater intake as a means of limiting the amount of weeds that can directly impact the submerged water intake (see Figure 13). However, the ranchers still must clean the debris from the submerged fence. In order to minimize safety concerns due to the cleaning of the submerged fence, CCWD may allow The ranchers access to the afterbay boat ramp so that the ranchers can use a small boat to clean the submerged fence around the intake. CCWD is also considering installation of an airburst system (a compressor that would blow air to clean the inlet screen). The airburst system appears to be the least costly alternative, however there are concerns regarding its cleaning effectiveness and system maintenance and so this alternative will be further vetted. CCWD is also considering a new floating pump raft system. The floating pump raft system could be pulled to shore for cleaning so the ranchers could use the proposed boat ramp to access the suction line.

Irrigation Valves There are two existing valves used to withdraw water from downstream of the RSFS to irrigate a private landowner's agricultural field. As shown in Figure 14, the two existing valves will be replaced and one new valve installed. All ditches and wetted areas will be avoided during access to the work sites. Each valve will require a 10 foot deep excavation over a 10 foot by 10 foot area. The spoils will be placed immediately next to the excavation site. Once the valve work is completed, the spoils will be placed back into the excavated area and any remaining spoils will be spread around the work area. All work will be conducted from May 1 through October 31. Once the valve work is completed, it is expected all O&M actions will be conducted by the landowner pursuant to a Reclamation issued land use authorization.

Figure 13 Photograph of Chain Link Fence Surrounding Ranchers' Intake

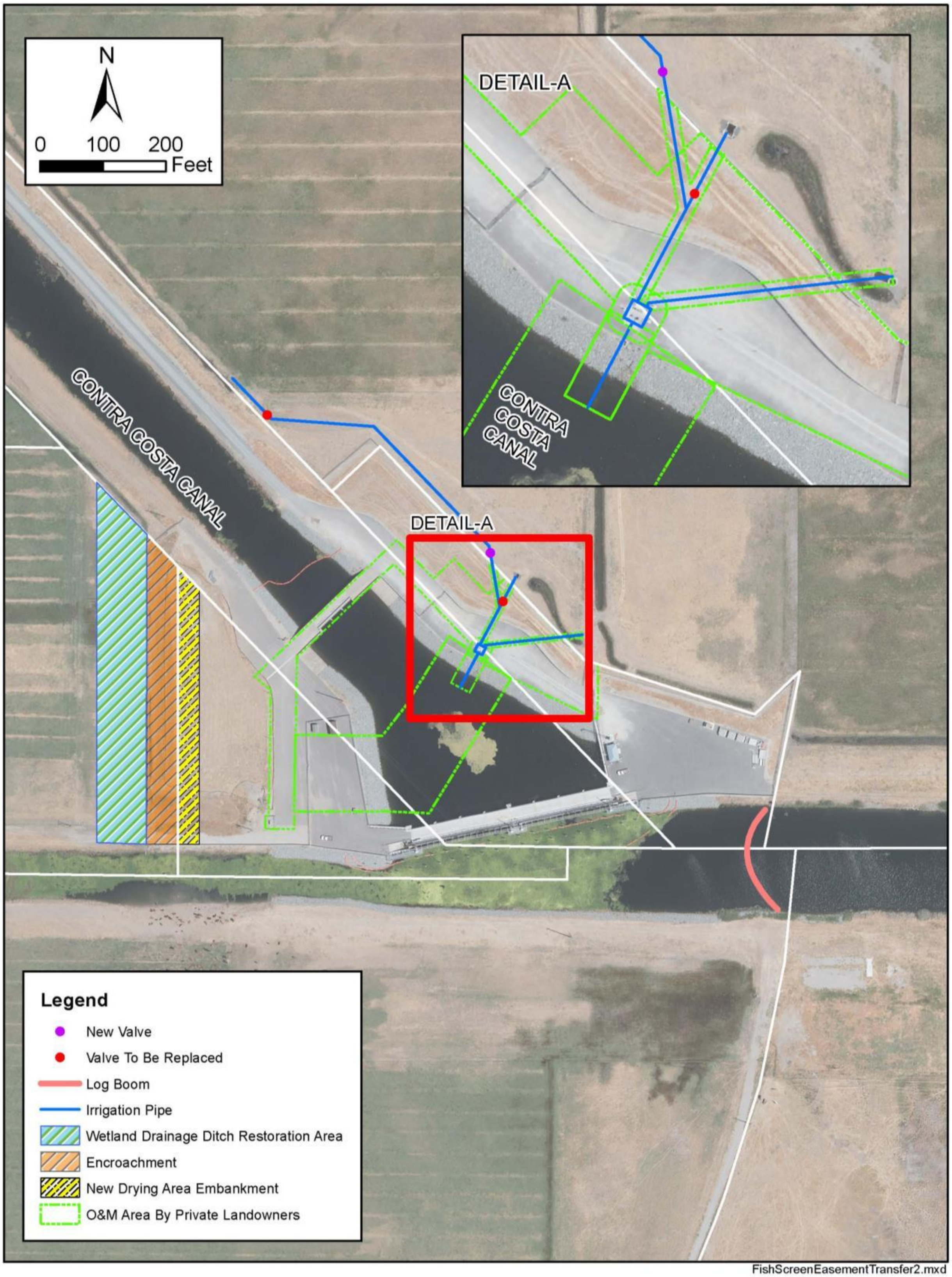

Figure 14 Proposed Irrigation System Improvements

Site Access
The primary route to the Project area is from East Cypress Road in the City of Oakley (see Figure 1). Construction crews and equipment will enter Reclamation right-of-way on the existing northeast aggregate (gravel) maintenance road along the unlined portion of the Canal. Equipment and construction crews will travel approximately 1.5 miles along the northeast maintenance road towards the start of the unlined portion of the Canal near the confluence with Rock Slough where the fish screen is located. CCWD will likely need to access the south side of the log boom from Delta Road along an existing private gravel road (future Bethel Island Road Extension Right of Way).

Staging Areas & Parking
The RSFS Facility site includes substantial paved and unpaved areas that can be used for temporary construction and staging to accommodate construction equipment, materials, fuels, lubricants, and solvents. Petroleum products will be stored in areas with secondary containment and will be handled according to a spill prevention plan to be developed for the construction work before work begins.

Equipment
Excavators, backhoes, loaders, fork lifts, compaction equipment, work boats, welders, pavers, and dump trucks will be required for construction of the improvements. A crane or boom truck will be needed to maneuver the rakes into place and perhaps to set the precast sections of the boat ramps.

Fencing
The perimeter property boundary surrounding the Canal and the RSFS Facility has been secured by installation of a six-foot chain link fence. In the event that a settlement is not made with the property owner on the encroachment land area matter described above, CCWD intends to place a temporary fence (three-strand barbed wired) or fiberglass markers on the correct property line approximately 50 feet from the existing fence. This will ensure that all future work and maintenance remains within the RSFS Facility property boundary. CCWD will likely continue to use and maintain this property until the land area encroachment is resolved.

Silt Curtains
Silt curtains will be installed within the water during construction of the two boat ramps. This will minimize any turbidity during boat ramp construction from extending into Rock Slough or the Canal. The silt curtain will have a floating plastic boom that will support the curtain. The curtain will be an impermeable membrane that extends from the float at the water's surface to the invert of the channel. The bottom of the curtain is weighted to hold it in place and the ends of the floating boom are anchored. The silt curtain is installed with a workboat and lifting equipment for unloading. An estimated construction sequence is provided in Table 3. The timing of construction will be dependent on available funding and permitting of the Project.

Table 3 Summary of the Project Construction Sequence

Activity Type	Activity Window	Construction Duration (Within Activity Window)
Log Boom Relocation	June	2 weeks

Nesting Bird Deterrent Paint, Netting, and Spiking	September – October	4 weeks
Rake Modifications	April - September	3 months
Debris Handling Systems	April - September	2 months
Extend the Rake Motor Access Platform	April - September	2 months
Boat Ramps	April - September	2.5 months
Rakes 1-4 Testing	November – March	2 years
Miscellaneous Improvements	May – October	2 months

2.2.2 Ongoing O&M of the RSFS Facility

Operation of the improved RSFS includes several tasks. The automatic rake system will be operated to ensure that screen is clean and approach velocities are achieved consistent with USFWS and NMFS requirements. CCWD will test the new rakes to ensure that they can be reliably and effectively operated once installed. CCWD will manage the debris that is removed by the operation of the rakes and also from behind the screens or is otherwise removed to maintain the operation of RSFS. Debris will be removed to the on-site drying area as necessary. The location of the on-site drying area is shown in Figure 2.

Fish and debris monitoring data will be used to assess the presence of salmonids and other listed fish species. Fish data will be collected during CCWD's routine sieve net monitoring program, either weekly (mid-December through mid-July) or monthly (late-July through early-December) and also during debris monitoring while the rakes are operating. Debris monitoring entails identifying the type and amount of debris (and any fish) removed by the rakes during their operation. Visual observations of the intake forebay area are also conducted during debris monitoring. If listed fish species are present, Reclamation will collaborate with CCWD and the appropriate Service(s) to determine the best approach to minimize and avoid effects. The approach to minimize or avoid effects may include operating the rakes in the brush only mode, operating only during ebb tides, or periodically shutting down the rakes if possible. The daily operations of the RSFS are provided in Table 4.

Table 4 Potential Effects to Listed Species from Proposed Daily Operations for the RSFS

Activity	Description	Listed Species Potentially Affected and Likelihood of Affect	Avoidance and Minimization Measures
Rake Operation	As required based on screen differentials readings (water elevation levels in front and behind the RSFS) and consideration of potential for listed salmonid occurrence (November through April). Rake mechanism cycle timer will be adjusted based on screen differentials with the objective of maintaining uniform approach velocities.	Giant garter snake – low, presence not documented in the Action Area. Listed Fish – Medium-High for salmonids. Low for delta smelt, longfin smelt, and green sturgeon.	None identified for Giant garter snake. Brush only mode when salmonids are in area; no measures for smelts. Operate once per day; apply deterrent coating.
Manage Debris	As required. Less frequently when debris loading is limited and more frequently when debris loading is extensive. Debris is transported to the	Giant garter snake – low	Slow equipment speeds, observe road while transporting, and observe drying area

	paved area and dried on site.		before placement.
Monitoring	Use fish monitoring data to assess possible presence of listed fish. Use debris monitoring to assess frequency of rake operations.	N/A	If listed fish are present at the RSFS, then assess approach to minimize and avoid effects.

2.2.3 Proposed O&M Activities

CCWD has been maintaining the RSFS since Reclamation completed construction of the facility in 2011 consistent with O&M activities covered in the USFWS February 17, 2005 BiOp (1-1-04-F-0368) (USFWS 2005a). This BA considers the ongoing O&M from this 2005 USFWS BiOp as well as additional actions not previously covered for the RSFS Facility that may be implemented for the Project (see Table 5). Table 5 identifies the 41 O&M activities proposed for the RSFS Facility that could occur in the vicinity of the RSFS Facility (the 2005 USFWS BiOp identifies up to 59 O&M activities). The identified O&M activities are based on CCWD’s experience at the RSFS, within the Canal system and at its other screened Delta intakes, and could be subject to change as specific experience maintaining the RSFS Facility is obtained. As shown in Figure 2, the O&M activities will apply to both land and water area owned by Reclamation between the Canal Headworks/ Flood Isolation structures and the area in front of and around the RSFS Facility up to the property line where the relocated log boom was placed across Rock Slough (some of these areas are on private property).

Table 5 Proposed O&M Activities on Land and Water

Identification Number*	Operation and Maintenance Activity	Applies to Land	Applies to Water
1.	Aquatic Weed Contact Herbicide Application		X
2.	Blading and Discing of Rights-of-Way	X	
3.	Blading of O&M Roads	X	
4.	Canal Bank Revegetation	X	
5.	Canal/Tunnel/Conduit Liner Repair	X	X
8.	Contact Terrestrial Herbicide Applications	X	
10.	Canal Dewatering		X
11.	Drain, Ditch, and Channel Maintenance	X	X
13.	Hand and Mechanical Control of Vegetation	X	X
14.	Insecticidal Sprays	X	
15.	Mudjacking and/or Injecting Grout	X	X
16.	Pre-emergent Herbicide Applications	X	
18.	Rights-of-Way Dust Abatement	X	
19.	Rights-of-Way Mowing	X	
20.	Rip Rap	X	X
22.	Squirrel Baiting	X	
23.	Bargate/Fence Installations	X	
24.	Bridge Maintenance (running pad replacement)	X	X
25.	Cableway Maintenance (painting/cleaning/repair)	X	X
29.	Drainage Improvements (ditches or pipe)	X	
30.	Electrical Repairs by Utility Companies (PG&E, SCE, WAPA, or others)	X	

Identification Number*	Operation and Maintenance Activity	Applies to Land	Applies to Water
31.	Embankment Maintenance (filling washes and gullies)	X	
32.	Facilities Inspection	X	X
33.	Graffiti Removal from Concrete Structures	X	X
34.	Guardrail Installation/Repair	X	
35.	Valve Rehabilitation	X	
36.	Ladders/Safety Nets/Float/Log Boom Repair and Replacement	X	X
37.	Pull and Check Pumps	X	X
39.	Instrument Recorder House Maintenance (door repair, painting, cleaning, etc.)	X	
40.	Removal of Trash or Debris	X	X
41.	Rights-of-Way Trash Removal	X	
42.	SCADA System Repair and Upgrade	X	
43.	Sign Repair/Replacement/Installation	X	X
44.	Stilling Well Maintenance (pumping/backflush, etc.)	X	X
48.	Utility Trenching (SCADA/Power/Misc.)	X	
49.	Wash and Paint Turnouts and Check Structures (includes Headworks/Flood Isolation and RSFS structures)	X	X
50.	Wash Bridges and Fish Screens	X	X
53.	Canal Desilting Operations	X	X
54.	Minor Road Construction/Rehabilitation	X	
57.	Structure Construction (blockhouses, stilling wells, etc.)	X	X
58.	Utility and Facilities Repair	X	X
*Note: Identification numbers are the numbers referenced in the 2005 USFWS O&M BiOp and are therefore not sequential.			

The 41 O&M activities are discussed individually below. These O&M activities are numbered as they were in the 2005 USFWS BiOp, and therefore are not numbered sequentially.

1. Aquatic Weed Contact Herbicide Application.

Invasive aquatic weeds have been a problem at RSFS Facility since construction was completed in 2011 (see Figure 15). Since that time, Tenera has documented the types and quantities of aquatic debris collected by the screen cleaning system. Additionally, during fish monitoring events at RSFS, Tenera has visually inspected and documented the composition of aquatic weeds located in front (upstream) of the fish screen. During these visual surveys, water hyacinth has had the largest presence among the aquatic weeds at the RSFS. Water primrose has occasionally emerged among the floating flora, however to a lesser extent than water hyacinth. Submerged aquatic weeds in front of RSFS includes Brazilian elodea, coontail, and filamentous algae, with Brazilian elodea being the dominant species. Of the quantities of weeds collected by the rakes at RSFS, Brazilian elodea has dominated, followed by water hyacinth and coontail. The percent composition of aquatic weeds collected by the screen cleaning system is provided in Figures 16 through 19.

Figure 15 Aquatic Weeds at the RSFS Facility

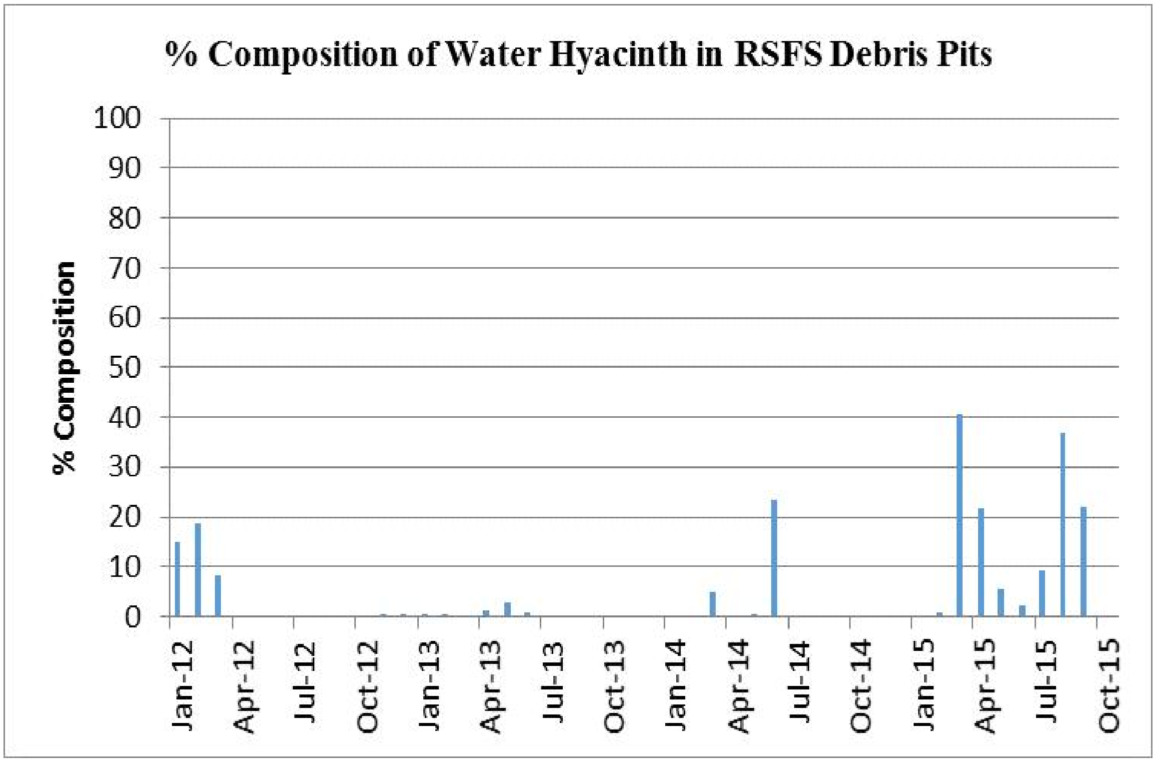

Figure 16 Percent Composition of Water Hyacinth (January 2012 through 2015)

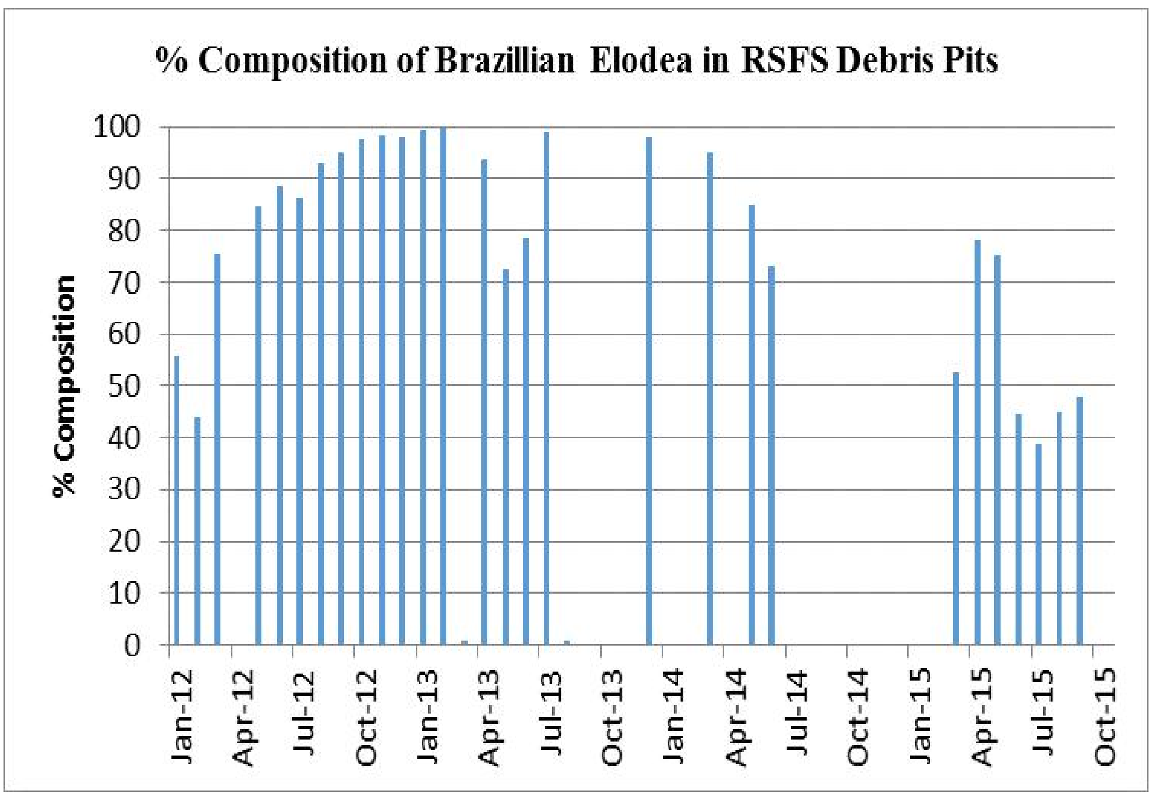

Figure 17 Percent Composition of Brazillian Elodea (January 2012 through September 2015)

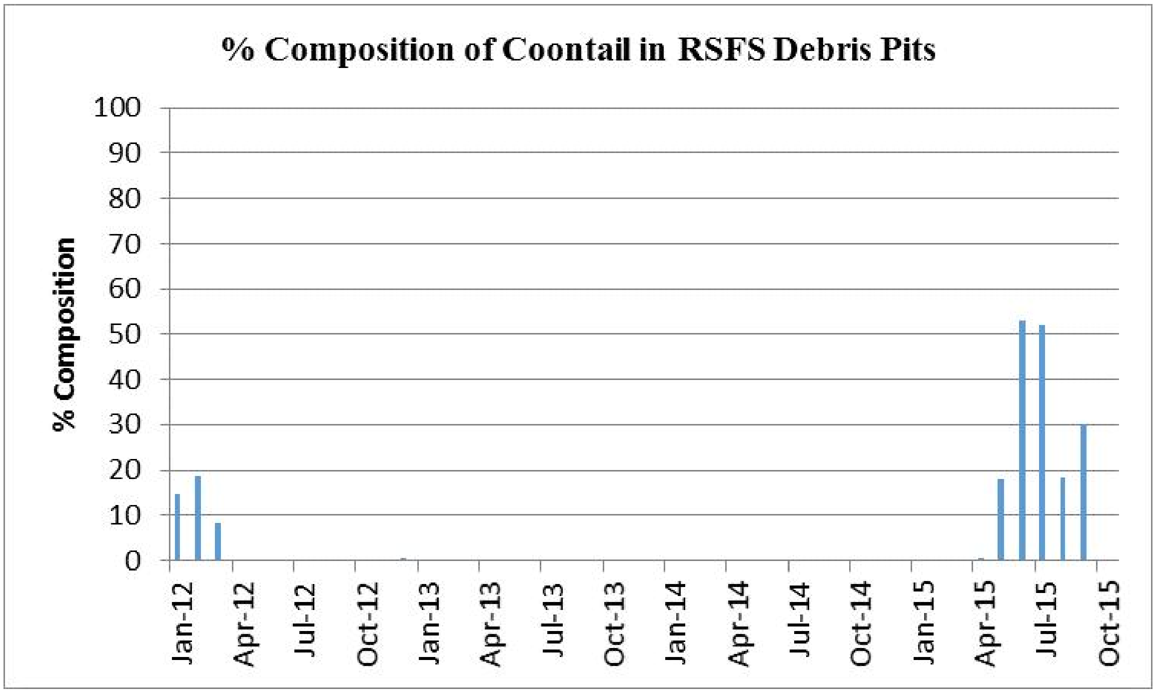

Figure 18 Percent Composition of Coontail (January 2012 through September 2015)

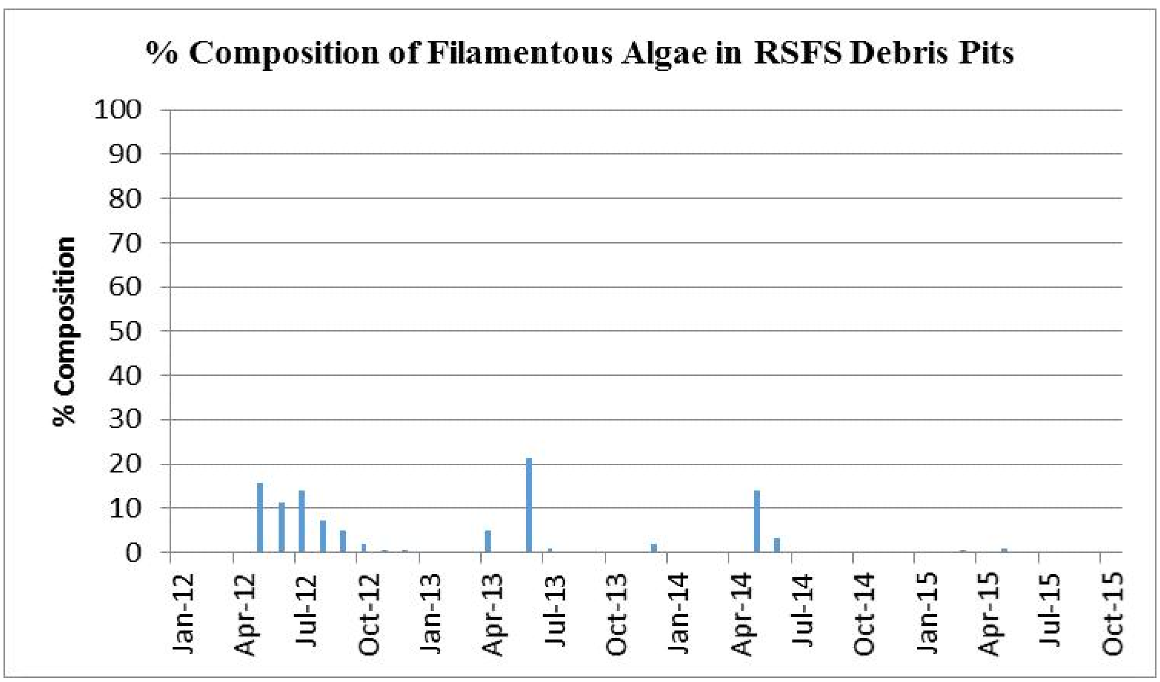

Figure 19 Percent Composition of Filamentous Algae (January 2012 through September 2015)

The extent of the area where herbicide will be applied varies and will depend on the distribution of aquatic weeds, but is generally the area from downstream of the RSFS to Headworks/Flood Isolation structures (intake afterbay) and the area upstream of the RSFS from the Rock Slough Extension to the area where the log boom was relocated (this is approximately 800 feet upstream of the RSFS). Herbicide application will occur in the same area as mechanical harvesting (see Figure 2). The proposed application area in front of the RSFS and Rock Slough Extension is estimated at approximately four acres and the area within the Canal downstream of the fish screen and upstream of the Headworks Structure is estimated at two acres.

Herbicides will be delivered from pressurized tanks and sprayed from vehicle and/or boat mounted booms, via backpack sprayers, or other application rig, or by manually wicking herbicides directly onto vegetation. Aerial spraying using aircraft will not be conducted. Applications will be made following the herbicide label instructions and are timed to occur when weeds are most susceptible, which is usually when plants are young or are actively growing (commonly as early as March or as late as October). The best time to treat the weeds is generally when the plants are just beginning to grow (during the spring). Treatment during this period will minimize the amounts of herbicides required for adequate control; mature plants require more product to ensure effective treatment. However, the application schedule depends on the mode of action of the herbicide and plant phenology. It is anticipated that the majority of herbicide application will occur from June through October and CCWD will follow its approved IPMP (Appendix B), or updates, and Reclamation's requirements (i.e., Reclamation Manual Env. 01-01) while applying herbicides within Rock Slough or the RSFS intake afterbay. IPMP Plans are reviewed regularly and are modified as new compounds become available.

CCWD evaluated several strategies for applying aquatic herbicides in order to avoid and minimize effects to listed species to the extent possible while still meeting needs for controlling weeds that compromise the operation of the RSFS Facility. CCWD proposes to conduct mechanical harvesting and aquatic herbicide application from June 1 through October 31, a period when listed fish species are least likely to occur in the vicinity (see discussion below). CCWD chose the least toxic herbicides out of a suite of herbicides approved for use in California. It is important to clear the offshore area for following reasons: 1) to ensure that the rakes can operate effectively so that velocities remain at or below agency requirements; 2) to prevent high differentials from damaging the screen panels or structures; and 3) so that observations can be made of Chinook salmon that generally appear at the RSFS in mid-November, which may require adjusting rake operations in order to prevent salmon entrapment.

In addition to the established August through October in-water work window allowed for delta smelt, CCWD proposes to apply aquatic herbicides and mechanically harvest in June and July, or earlier, if necessary. June and July were included in the period of proposed herbicide application based on CCWD and CDFW fish monitoring data (see Table 13). In order to apply herbicides in June and July, CCWD proposes to conduct ichthyoplankton monitoring three times a week regardless of the results of CDFW's surveys that either initiate or end CCWD's ichthyoplankton sampling. Samples will be processed immediately and results reported to CCWD and Reclamation. If larval/post larval smelts are found, CCWD will not conduct herbicide applications until such time that no smelts are collected during three consecutive sampling events.

During some years, there could be situations that occur outside of the June through October time period[5] when large quantities of weeds may threaten the integrity of the screen. CCWD proposes to use aquatic herbicides to alleviate the issues offshore of the screen. CCWD would advise Reclamation's Engineer and Biologist before any work commences. Work would not be

[5] Filamentous algae occurs as early as May and large amounts of Brazilian elodea can occur year round.

initiated without authorization from the Engineer. If further environmental review is required, CCWD would comply with the requirements.

CCWD will coordinate any herbicide application upstream of the RSFS with California Department of Boating and Waterways (CDBW) to avoid over application and to review dosage and post application monitoring procedures. Under an existing Memorandum of Understanding between CDBW and CCWD, CDBW is prohibited from applying aquatic herbicides within Rock Slough or within one mile of the confluence of Rock Slough and Old River without the prior consent of CCWD.

CCWD compiled a list of the problematic aquatic plants at RSFS using data collected during debris tracking. The main culprits are the non-native water hyacinth, Brazilian elodea, and water primrose, the native coontail, and filamentous algae. CCWD identified seven herbicides that could help to control the presence and spread of the pestiferous aquatic plant species at RSFS: Aquathol® K, Cascade®, Clearcast®, GreenClean® Liquid 2.0, Phycomycin® SCP, Roundup Custom™, and Teton®. After careful consideration of the effects of the herbicides, three herbicides were eliminated: Aquathol® K, Cascade®, and Teton®. The remaining four herbicides (Clearcast®, Roundup Custom™ GreenClean® Liquid 2.0, and Phycomycin® SCP) and the active ingredients proposed for use by CCWD and the aquatic plants they control are listed in Table 6.

Table 6 Herbicides Proposed to Control Aquatic Vegetation in the vicinity of the RSFS

Brand Name	Active Ingredient	Target Species	Degradation	Application	Restrictions	Toxicity	Notes
Clearcast®	Ammonium salt of imazamox (12.1%)	• Water hyacinth • Water primrose • Coontail • Brazilian elodea	• Half-life 4 to 49 days	• Broadcast or spot spray • Water hyacinth: 16-32 fl oz/acre; 50-200 ppb • Water primrose: 32-64 fl oz/acre; 50-200 ppb • Coontail: 200-500 ppb • Brazilian elodea: 200-500 ppb	Treated water not potable 6 days after application	***Fish*** • Bluegill: 96-hr LC50 >119 mg/L; >119,000 ppb • : Rainbow trout: 96-hour LC50 >122 mg/l=122,000 ppb ***Arthropod*** • Honey bee LD50 > 100 µg	Do not apply when wind speed > 10 mph
GreenClean® Liquid 2.0	Hydrogen dioxide (27.1%)	Filamentous algae	100% within 24 hours	• Water application either by spot treatment (applied directly over infested area), liquid (solution sprayed from shore or boat), or injection (solution injected into water via a piping system) • For filamentous algae, 2.4-24.0 gal/AF or 0.5-5 ppm depending on algal growth/density	• Apply early in day under calm, sunny conditions when water temperatures are warm • Control most easily achieved when algae are not yet well established • Treat in early spring or summer when growth first begins to appear	***Fish*** • Rainbow trout: 48-hr, LC50 - >40 mg/L; > 40 ppm ***Arthropod*** • Highly toxic to bees ***Crustacean*** • EC50, 48-hr; 126.8 mg/l	
Phycomycin® SCP	Sodium carbonate peroxyhydrate (85%)	Filamentous algae	100% within 24 hours	• Broadcast or mechanical spreader, 3-100 lb/AF 0.3-10.2 ppm	• Control more easily achieved if treated soon after growth starts • Apply with 8-10 hours of daylight remaining, as decaying algae can deplete oxygen levels	***Fish*** • Bluegill: 96 hr LC50 320 mg/L; 320 ppm • Fathead minnow 96-hr LC50 70.7 mg/l; 71 ppm ***Invertebrates*** • Daphnia: 48 hr LC50 265 mg/L; 265 ppm Arthropods	

Brand Name	Active Ingredient	Target Species	Degradation	Application	Restrictions	Toxicity	Notes
						• Highly toxic to bees	
Roundup Custom™	Glyphosate (53.8%)	• Water hyacinth • Water primrose	Half-life 12 days to 10 weeks	• Ground broadcast: 3-7.5 pints/acre (upper end for high density) • Handheld: 1.5% solution by volume for spray-to-wet, 4-8% for low-volume directed spray • Apply after reproductive stage of growth	Potable water intake must be turned off for a minimum of 48 hours if application is within 0.5 miles of intake, unless glyphosate level <0.7 ppm	***Fish*** Rainbow trout: Acute, 96 hr, static, LC50: >1000 mg/L ***Invertebrates*** Daphnia: Acute, 48 hr, static, EC50: 930 mg/L ***Avian*** Mallard duck: Dietary, 5 days, LC50: >4,640 mg/kg diet ***Arthropod*** Honey bee: 38 hours LD50: oral 100 µg, contact > 100 µg	Requires use of nonionic surfactant (2+qts/100 gal)

Notes: LD50/LC50 is the amount of an ingested substance that kills 50% of a test sample.
EC50 is the concentration of a toxicant at which 50% of its maximum response is observed.

Clearcast® Clearcast® is a systemic herbicide used to control/suppress certain submerged, floating, and aquatic vegetation. It may be broadcast-applied to the water surface or injected below the water surface under surface-matted conditions. It may also be applied aerially by both fixed-wing aircraft and helicopter. Its active ingredient is ammonium salt of imazamox (12.1%) (Clearcast® Specimen Label). At RSFS, Clearcast® will be effective at controlling water hyacinth, and to a lesser extent coontail and Brazilian elodea. Clearcast® also is effective at controlling pondweed, watermilfoil, hydrilla, and water stargrass (Clearcast® Specimen Label). It is a systemic herbicide which acts by moving throughout the plant tissue, preventing plants from producing a necessary enzyme (acetolactate synthase) which is not found in animals. Treated plants will stop growing after treatment, and plant death and decomposition will occur over several weeks (WDNR 2012a). Water treated with Clearcast® is considered potable six days after treatment. Imazamox has a half-life ranging from 4 to 49 days in lakes, however breakdown does not occur in deep, poorly oxygenated water with no light. In this case, imazamox will bind to sediment rather than breaking down, resulting in a half-life of two years. Its breakdown products are nicotinic acid and di- and tricarboxylic acids, none of which are herbicidal or suggest concerns for aquatic organisms (WDNR 2012a). Imazamox is classified by the U.S. Department of Agriculture (USDA) as practically non-toxic to fish and aquatic inverts, and it does not bioaccumulate in fish. Toxicity (LC50, 96 hr) for rainbow trout is greater than 122 mg/L (SWRCB 2013) and is greater than 119 mg/L for bluegill (Clearcast® Material Safety Data Sheet [MSDS]). Laboratory tests using rainbow trout, bluegill, and water fleas indicate that imazamox is not toxic to these species at label application rates (USDA and CDBW 2012). Imazamox is not acutely harmful to terrestrial organisms, and is toxic to birds only at dosages exceeding approved application rates. Honeybees are affected at application rates, so application should be in a manner that does not allow for drift into blooming crops or weeds while bees are actively visiting the treatment area (Clearcast® Specimen Label). Toxic impacts to amphibians and reptiles resulting from the application of imazamox are highly unlikely (USDA and CDBW 2012a). CCWD will apply the product according to labeled rates (see Table 7).

Table 7 Clearcast® Herbicide Application Rates per Treated Surface Acre

Average Water Depth of Treatment Site (feet)	Desired Active Ingredient Concentration (ppb)*			
	50 ppb	100 ppb	200 ppb	500 ppb
	Clearcast® Rate per Treated Surface Acre (fl oz)			
1	17	35	69	173
2	35	69	138	346
3	52	104	207	518
4	70	138	277	691
5	87	173	346	864
6	104	207	415	1,037
7	122	242	484	1,210
8	139	277	553	1,382
9	157	311	622	1,555
10	174	346	691	1,728

*Clearcast® contains 1.0 pound of active ingredient per gallon. There are 128 fluid oz in one gallon.
Source: Clearcast® Specimen Label.

GreenClean® Liquid 2.0 GreenClean® Liquid 2.0 is a broad spectrum algaecide/bactericide used to treat filamentous algae and cyanobacteria. Its active ingredients are hydrogen dioxide (27.1 %) and peroxyacetic acid (2.0%). It acts by oxidizing the algae, destroying algal cell membranes and chlorophyll (GreenClean® Liquid 2.0 Specimen Label, WDNR 2012b). GreenClean® Liquid 2.0 is toxic to birds, fish, and bees (GreenClean® Liquid 2.0 Specimen Label). CCWD will apply GreenClean® Liquid 2.0 according to the labeled rates (see Table 8). GreenClean® Liquid 2.0 toxicity (LC50, 48 hr) to rainbow trout is greater than 40 mg/L and its toxicity to crustaceans (EC, 48 hr) is 126.8 mg/l. Its half-life is very short with nearly 100% degradation within 24 hours (GreenClean® Liquid 2.0 MSDS, BioSafe Systems 2013). The end product from breakdown is hydrogen and oxygen (WDNR 2012b). It is highly toxic to bees exposed to direct contact on blooming crops or weeds, so application should be in a manner that does not allow for drift into blooming crops or weeds while bees are actively visiting the treatment area (GreenClean® Liquid 2.0 Specimen Label). Treatment can result in oxygen loss from decomposition of dead or decaying algae; treatment should begin along the shore and proceed outward in bands to allow fish to move into untreated areas. Treatment of algae with GreenClean® Liquid 2.0 will be conducted through water application, either by surface injection, or by spot treatment. For spot treatment, GreenClean ® Liquid 2.0 is applied directly over the infested area (GreenClean® Liquid 2.0 Specimen Label). Retreatment is required when heavy growth appears; CCWD will allow 48 hours between consecutive treatments. Control is most effective when algae are not yet established and water temperatures are warm. Therefore, CCWD will apply in the summer during the morning under calm, sunny conditions when the water temperature is at least 60°F (GreenClean® Liquid 2.0 Specimen Label).

Table 8 Application Rates of GreenClean® Liquid 2.0 based on Growth/density of Targeted Algae

Algae Growth/Density	Gallons of GreenClean® Liquid 2.0 per Acre Foot (AF)
Low Density	2.4
Moderate Density	6.0
High Density	10.8
Extreme Density (full bloom)	24.0
Source: GreenClean® Liquid 2.0 Specimen Label.	

Phycomycin® SCP Phycomycin® SCP is an algaecide and oxidizer used to treat filamentous algae and blue-green algae (cyanobacteria), as well as coontail at higher application rates. Phycomycin® SCP is similar to GreenClean® Liquid 2.0; however, it is granular in form. Its active ingredient is sodium carbonate peroxyhydrate (85%) (Phycomycin® SCP Specimen Label). Sodium carbonate peroxyhydrate acts by oxidizing algae, destroying algal cell membranes and chlorophyll (WDNR 2012b). It is toxic to birds and fish, but is considered non-toxic to birds and fish when used at the labeled rates (Phycomycin® SCP Specimen Label). CCWD will apply at labeled rates (see Table 9). Its toxicity (LC50) to fathead minnow is 70.7 mg/L (sodium carbonate peroxyhydrate MSDS) and is 320 mg/L to bluegill (Phycomycin® SCP MSDS). Its half-life is very short with nearly 100% degradation within 24 hours (Phycomycin® SCP Specimen Label, BioSafe Systems 2013). The end product from breakdown is hydrogen and oxygen (WDNR 2012b). It is highly toxic to bees exposed to direct contact on blooming crops or weeds, so application should be in a manner that does not allow for drift into blooming crops or weeds while bees are actively visiting the treatment area. Treatment of algae with Phycomycin® SCP is conducted by broadcasting or use of a mechanical spreader. Control is most effective when water temperatures are warm, so CCWD will apply early in the day under calm, sunny conditions when the water temperature is at least 60°F (Phycomycin® SCP

Specimen Label). CCWD will apply from the shallow water and proceed towards deeper waters to allow fish and mobile biota the opportunity to move away from the treatment area.

Table 9 Maximum Dosage Rates of Phycomycin® by Volume of Water Treated

Gallons	200	500	750	1,000	2,000	10,000	100,000	325,851
Dosage	34 g	68 g	100 g	135 g	270 g	3 lb	30 lb	100 lb
Source: Phycomycin® SCP Specimen Label.								

Roundup Custom™ Roundup Custom™ is a systemic herbicide used to treat aquatic plants growing above water. Its active ingredient is glyphosate (53.8%), and it acts by inhibiting an important enzyme needed for multiple plant processes, including growth (Roundup Custom™ Specimen Label, WDNR 2012c). At RSFS it will be effective in controlling water hyacinth and water primrose. It is applied at the surface either aerially, via broadcast equipment, or by handheld equipment (Roundup Custom™ Specimen Label). A surfactant approved for aquatic sites must be used in conjunction with Roundup Custom™ to help the herbicide stick to the plant surfaces and to increase the rate of absorption (WNDR 2012c). For controlling water hyacinth the ideal herbicide treatment time is when the plant is in the early growth phases, which in the Delta has historically occurred between early May and the end of June (USDA and CDBW 2012a). After application, plants will gradually wilt, appear yellow, and die in approximately two to seven days (WNDR 2012c). Roundup Custom™ cannot be applied within ½ mile upstream of an active potable water intake. If application is made within ½ mile upstream of a potable water intake, intakes must remain off for 48 hours after treatment, unless assay determines glyphosate level is below 0.7 ppm. The pumps at PP1 are nearly four miles from RSFS treatment area. In water, glyphosate has a half-life between 12 days to ten weeks, depending on water conditions (Tu et al. 2001). Concentration of glyphosate is reduced through rapid dispersal by water movement, by binding to sediments, and through breakdown by microorganisms. The primary breakdown product is aminomethylphosphonic acid, which is further broken down by microbes in the water and soil, and is considered not to pose any hazards distinct from glyphosate (WNDR 2012c). Laboratory testing indicates that Roundup Custom™ is toxic to fish only at dosages well above label application rates (WNDR 2012c). CCWD will apply according to label application rates. Acute toxicity (96 hr, LC50) to both rainbow trout and bluegill is greater than 1,000 mg/L. It is no more than slightly toxic to birds and is practically non-toxic to bees. It is relatively non-toxic to domestic animals, however ingestion of large amounts of freshly sprayed vegetation may result in temporary gastrointestinal irritation (Roundup Custom™ Specimen Label). The use of glyphosate can result in oxygen depletion by decomposition of dead plants, therefore in order to prevent fish kills caused by dissolved oxygen (DO) depletion only one-third to one-half of any water body should be treated at any one time (Tu et al. 2001).

2. Blading and Discing of Rights-of-Way

A grader or tractor with mounted blade or disc is used to scrape or shallowly till the soil to kill, prevent, or retard growth or spread of weeds, to reduce cover for pests, and to limit vegetation fuel load while providing fire breaks. Blading is practiced, in part, to reduce reliance on chemical herbicides and minimize development of herbicide resistance in weeds. Blading and discing is conducted along rights-of-way (following canals and pipelines or conduits and their access routes) and around support facilities and structures. Blading and discing may be conducted at any time of year, but is concentrated in the dry period (March through November).

The action may be conducted once to several times a year, as needed to control weedy vegetation.

3. Blading of O&M Roads
A grader or tractor with a mounted blade is used to scrape unpaved roadways and road shoulders to remove weedy vegetation, ruts, and to level and maintain the surface for access to the Project. Blading occurs during the dry season, primarily from May through November. Machinery disturbs soil on the roadway and on the shoulders.

4. Canal Bank Revegetation
Revegetation with native non-weedy plants is conducted to stabilize slopes and prevent erosion, retain support of the Canal, exclude weeds, and also provide wildlife habitat. Prior to revegetation, plots are scarified either by a gradall, loader, or klodbuster if they are on slopes, or by a disc if on level terrain. Large flat plots are drilled, and hilly terrain is hydro-seeded. Small (approximately 30 feet by 60 feet) test plots are hand broadcast. Plots may be mulched with straw, which may be tackified with wood fiber and a mulch tackifier to hold it in place. CCWD will use hydroseeding to control erosion on slopes both inside and outside of the levee.

5. Canal/Tunnel/Conduit Liner Repair
Liners, tunnels, and conduits are typically constructed of reinforced concrete. Cracked or broken liner panels, damaged sections on canals, or areas on wasteways and the aprons or outlets from canals are patched with concrete, grout compound, shotcrete, or other similar material that is pumped, blown, or fed from a mixer by gravity.

A damaged liner that cannot be repaired is overlaid with shotcrete or removed with heavy equipment and a new panel is fashioned in place. When panels are removed, the soil behind the panel may be excavated and then recompacted; re-bar is installed before concrete is poured in place. Repairs usually are made when facilities are dewatered or water delivery is minimal, often in the fall and winter. However, repairs may be conducted from winter through the end of March on the Canal.

8. Contact Terrestrial Herbicide Applications.
Contact herbicides are applied to control vegetation on canal banks, on rights of way, around water intakes and other structures, and at facilities compounds. Herbicides approved for use in California by the U.S. Environmental Protection Agency and the California Department of Pesticide Regulation are applied to check growth of vegetation that could threaten the integrity of facilities or foul its operation, maintain access to facilities, enable facilities inspections, reduce fire hazards, and to reduce the spread of noxious or invasive weeds. Additionally, contact herbicides are sprayed to reduce or eliminate habitat for pests, enhance security surveillance, and provide for a well-kept appearance at facilities. Herbicides are delivered from pressurized tanks and sprayed from vehicle mounted booms, via backpack sprayers or other application rig, bean gun, wand, or by manually wicking herbicides directly onto vegetation; aerial applications using aircraft are not conducted. Applications are made following instructions on the label and are timed to occur when weeds are most susceptible, usually when plants are young or are actively growing (commonly from February through October), although this depends on the mode of action of the herbicide and plant phenology. One or more applications are made annually as needed, depending on weed pressure and need for control. A typical regimen for weed control

includes pre-emergent applications for control of winter annuals, followed by one to several applications of contact herbicides for control of other annuals, which may be integrated with mechanical controls. CCWD will follow its approved IPMP (Appendix B), or updates, and Reclamation's requirements (i.e., Reclamation Manual Env. 01-01) when applying contact herbicides.

Two contact terrestrial herbicides are used by CCWD: Capstone® and Roundup Custom™. Capstone® is used for control of annual and perennial broadleaf weeds, woody plants, and vines. It is labeled for use on rangeland, permanent grass pastures, forests, non-cropland areas (airports, communication transmission lines, electrical power and utility rights-of-way, industrial sites, roadsides, railroads, etc.), natural areas, and Conservation Reserve Program sites. Capstone's® active ingredients are Triisopropanolammonium salt of 2-pyridine carboxylic acid, 4-amino-3,6-dicholoro- (2.2%) and Triethylamine salt of [(3, 5, 6-trichloro-2-pyridinyl) oxy]acetic acid (16.22%). It may be applied either through ground broadcast, or by handheld equipment for foliar or spot application.

Roundup Custom™ is a broad-spectrum post-emergence herbicide used for aquatic, crop, non-agricultural crop, industrial, turf, ornamental, forestry, roadside, and utility rights-of-way weed control. Roundup Custom™ active ingredient is glyphosate (53.8%). It provides control of annual weeds, perennial weeds, woody brush, and trees. Roundup Custom™ works by inhibiting the production of an enzyme that is essential to the formation of specific amino acids.

10. Canal Dewatering

Dewatering is done to facilitate maintenance of canal facilities, including repair or replacement of liner or inspecting or repairing siphons. During the process, water to one or more sections of the Canal is "cut off". In some cases, water may be pumped "upstream" behind a check or control structure. The action is conducted when demand for Canal use is lowest (usually October through March).

11. Drain, Ditch and Channel Maintenance

This maintenance is conducted to ensure conveyance of water through facilities or away from facilities. Surface (e.g., ditches, flumes, and overchutes) and subsurface (e.g., downdrains, pipes, and underchutes) drains, as well as the main channels of canals are maintained. Maintenance includes cleaning debris (both large and small), trash, soil, sediment, and vegetation from open ditches, canals, and areas in front of the RSFS, reshaping them with heavy equipment if necessary. Debris and vegetation that periodically accumulates in collecting basins or pipe is removed by hand or with a shovel. If piping is cracked, soil may be excavated and piping replaced. Backhoes, gradalls, excavators, dredges, draglines, tractors, and hand shovels may be used to remove material in surface areas.

Cleared soil and vegetation may be piled on adjacent land or, when extensive, may be transported in trucks to a spoil site. Activities occur primarily in fall and spring, but are concentrated during the end of the dry season (especially August through October) and before fall rains begin. Soil on ditch banks and soil and vegetation that occurs along banks and in depressions is disturbed or removed.

13. Hand and Mechanical Control of Vegetation.

Hand control is used to remove small amounts of nuisance or weedy vegetation at facilities or around structures where use of equipment or herbicides is impractical, such as where the extent of the problem is small. Removal is done by hand pulling vegetation, or removing it with aid of stringed weed cutters, spades, hoes, shovels, adzes, saws, or other hand implements. Disturbance occurs from cutting and removal of vegetation.

CCWD and/or its designee would mechanically harvest aquatic weeds from the area in front of the RSFS from the Rock Slough Extension to approximately 100–200 feet beyond the log boom, and from the area downstream of the fish screen and upstream of the Rock Slough Headworks Structure (see Figure 2). The harvester will cut the weeds at a depth of approximately five feet below the water surface. In shallower areas (six feet deep or less), the harvester will cut the weeds as close to the bottom as practicable. No disturbance of the bottom of Rock Slough or the Canal would occur. Cut aquatic weeds will then be pulled up onto the harvester via conveyor belt until the harvester is full. Once full, the aquatic weeds will be pulled off the harvester by a crane at the RSFS. It may be necessary to use an excavator to scoop out the weeds using the bucket and the thumb. The aquatic weeds will then be loaded onto trucks or other equipment and transported to the drying area (see Figure 2 for the location of the drying area). The aquatic weeds will be dried on site within the drying area that is currently used to dry aquatic weeds removed by the RSFS rakes. Once the weeds have dried sufficiently, they will either be removed or composted on site. Mechanical harvesting is proposed to occur from June through October.

During some years, there could be situations that occur outside of the June through October time period caused by large amounts of aquatic weeds offshore of the screen that threaten the integrity of the screen. CCWD proposes to use mechanical harvesting, and other mechanical equipment including excavators, cranes, pontoon boats, etc. to alleviate the issues offshore of the screen. CCWD would advise Reclamation's Engineer and Biologist before any work commences. Work would not be initiated without authorization from the Engineer. If further environmental review is required, CCWD would comply with any and all requirements.

The proposed harvesting area in front of the RSFS and Rock Slough Extension is estimated at approximately four acres and the area within the Canal downstream of the fish screen and upstream of the Headworks Structure is estimated at two acres. Total time to harvest is expected to take approximately one week to complete (one acre/day at approximately two miles per hour).

14. Insecticidal Sprays

Arthropod pests can present a human health hazard for people allergic to stings or bites. Pesticides registered for use in California by the U.S. Environmental Protection Agency and the California Department of Pesticide Regulation are applied to control bees, wasps, spiders, ants, cockroaches, fleas, termites, mosquitoes, and other arthropods. Insecticides are applied year-round, as needed, but primarily from spring through fall, according to the product label. They are applied in and around remote sensing Supervisory Control and Data Acquisition (SCADA) stations, at inspection stations, and other structures along conveyance facilities and appurtenant structures. Materials applied vary, but often those with quick knock-down are dispensed directly from canisters. These may be applied by applicators or hired structural pest control specialists. Material applied at recorder houses, vaults, and outbuildings before precipitation events could lead to pesticide runoff. However, CCWD procedures ensure that no insecticidal sprays will enter the Canal or Rock Slough. All application of insecticidal sprays will follow the guidelines and procedures specified in CCWD's IPMP (Appendix B) and Reclamation's requirements (i.e., Reclamation Manual Env. 01-01). IPMP Plans are reviewed regularly and are modified as new compounds become available

15. Mudjacking and/or Injecting Grout.

Grout or fill (liquefied clay) is used to fill cracks in the canal liner and/or rip rap and voids behind the liner and/or rip rap. When leaks appear on the outside of the prism of the Canal, or are associated with liner voids or cracks, holes are bored behind the liner with an auger and grout or fill is gravity fed from a mixer through tubes or hole borings into the void. When no additional material is accepted into borings and leakage stops, the leak is assumed to be patched and additional borings are unnecessary. The grout or fill restores physical support to the Canal liner, rip rap, and levee, which otherwise could fail due to the force on the liner and/or rip rap from water inside the Canal. Failure could result in a "blowout" that would flood surrounding land. Repairs are conducted when defects are discovered, with work preferentially conducted during dewatering. If required, this work would be conducted on a small section of concrete liner upstream of the Headworks Structure.

16. Pre-emergent Herbicide Applications.

These applications are made as part of weed control programs that deal with nearly year-round weed problems that exist in much of the San Joaquin CVP project area. Where weeds are not tolerated, such as on the inner prism of canal banks adjacent to the liner, weed germination is suppressed with pre-emergent herbicides to limit the spread of noxious or invasive weeds, reduce habitat for pests, help maintain access to facilities, enable inspections, check growth that could threaten facility integrity, limit fuel load and reduce fire hazards, and to provide for a well-kept appearance of facilities. Like contact herbicides, pre-emergent herbicides are applied around water intakes, on canal banks (particularly inner banks), on rights-of-way, around structures, and at facilities compounds. Applications are made following the herbicide label instructions and are timed to occur when weeds are most susceptible. Unlike contact herbicides which are applied directly to foliage, pre-emergents are applied to soil before seeds germinate, usually once annually in fall or early winter. Applications are made from pressurized spray tanks with a vehicle mounted boom sprayer, a backpack sprayer, or for granular formulations, with spreaders. CCWD will follow its approved IPMP (Appendix B), or updates, and Reclamations requirements (i.e., Reclamation Manual Env. 01-01) when applying pre-emergent herbicides. Herbicides reduce vegetative cover that may be used by listed species or their prey.

Three pre-emergent terrestrial herbicides are used by CCWD: Dimension® 2 EW, Dimension® Ultra 40WP, and Capstone®. Capstone® specialty herbicide is used for control of annual and perennial broadleaf weeds, woody plants, and vines. It is labeled for use on rangeland, permanent grass pastures, forests, non-cropland areas (airports, communication transmission lines, electrical power and utility rights-of-way, industrial sites, roadsides, railroads, etc.), natural areas, and Conservation Reserve Program sites. Capstone's® active ingredients are Triisopropanolammonium salt of 2-pyridine carboxylic acid, 4-amino-3,6-dicholoro- (2.2%) and Triethylamine salt of [(3, 5, 6-trichloro-2-pyridinyl) oxy]acetic acid (16.22%). It may be applied either through ground broadcast, or by handheld equipment for foliar or spot application. Dimension® Ultra 40 WP provides control of annual grasses and broadleaf weeds. Its active ingredients (40%) are dithiopyr: 3, 5-pyridinedicarbothioic acid, 2-(difluoromethyl)-4-(2-

methylpropyl)-6-(trifluorormethyl)-S, S-dimethyl ester. Dimension® 2EW is a specialty herbicide provides pre-emergence and early post-emergence control of crabgrass, goosegrass, foxtail, spurge, and Poa annua. It comes in liquid, granular, and wettable powder formulations. Dimension 2EW's® active ingredients are dithiopyr (24.0%), cyclohexanone (13%), 2-ethylhexanol (1.9%), and toluene (0.1%).

18. Rights-of-Way Dust Abatement

Dust abatement is conducted to minimize fugitive dust where the unpaved (non-operational) roadway or outer Canal bank is graded and where construction is occurring or spoils soil is being hauled during work operations at the RSFS Facility. Typically, a water truck traverses the roadway or work area and sprays water directly onto the soil surface during single or multiple passes. Flooding also may be used to limit dust. Dust abatement will occur in the construction laydown areas for the installation of the boat ramps.

19. Rights-of-Way Mowing

Mowing is conducted with a rotary, sickle bar, or other mower blade attached to a tractor. Mowing is conducted primarily in spring to control weeds and reduce or eliminate the need for herbicide applications. Mowing equipment disturbs sites and reduces vegetative cover used by listed species or their prey.

20. Rip Rap

Rip rap is comprised of large rocks and boulders of varying sizes that are placed at dams, spillways, and canal or levee banks, especially near bridges and canal undercrossings, or water control structures, to prevent erosion of shorelines or embankments, and to strengthen the channel. The work is conducted when needed to protect banks, but it is preferentially performed during the dry season. Rock is delivered to the site by truck and trailer; dumped rock is piled with the aid of backhoes and excavators.

22. Squirrel Baiting

Rodenticides are applied to control ground squirrels that burrow into embankments, canal levees, at earthen fill dams, around buildings, at pumping stations and other facilities, on canals, or waterways. Burrowing is a nuisance, creates hazards, and can undermine the integrity of roadways and structures, by creating voids that weaken the integrity of conveyance structures or that lead to "piping" (water leakage). Toxic grain baits are made available by broadcast or in bait stations. CCWD uses the edible grain bait treated with Diphacinone. When not in use, traps are closed or bait removed. All baits will be applied according to the guidelines and procedures specified in CCWD's IPMP (Appendix B) and Reclamation's requirements (i.e., Reclamation Manual Env. 01-01). IPMP Plans are reviewed regularly and are modified as new compounds become available. CCWD will take steps to ensure that rodenticides do not enter the Canal or Rock Slough.

23. Bargate/Fence Installations

Gate and fence installations and repairs are made to limit access to facilities, to provide security and where safety or the protection of resources is a concern or encroachment is a problem. Barbed wire fencing is strung at perimeters of Reclamation rights-of-way. Chain link fence is installed where the public has access to facilities and it is necessary to protect public health and safety, or where it is necessary to protect the Canal or facilities from dumping or vandalism.

Bargates are installed where Canal rights-of-way intersect public roadways, such as at corners of bridges, on secondary and primary roads, and on parallel fences at or near structures. Holes for support structures for fencing and bargates are dug by hand implements, power auger, or backhoes. Barbed wire is attached to steel t-posts that are driven with a post driver; wooden braces and corners may be set as anchors if the fence is constructed around uneven terrain. Pipe rods are set in the ground with concrete to which chain link fencing is attached. Installations or repairs are made as needed. Gates are cleaned and painted when needed.

24. Bridge Maintenance (running pad replacement)
Bridge surfaces, including railings, are pressure washed with water, and when necessary painted by hand with brush or roller. Support pillars that have rotted or been damaged are removed with a crane or hoist and replaced with new pillars that are driven into place. Concrete decking may replace wooden decking. Support pillars are prepared with re-bar and concrete is poured in place in forms. Steel cross beam under-decking is lowered onto pillars and prefabricated concrete pads are lowered onto the cross beams using a crane. Maintenance is usually conducted in the spring or fall. This activity applies to both the Canal Headworks/Flood Isolation structures and RSFS bridge structures.

25. Cableway Maintenance (painting/cleaning/repair)
Cables and pulleys are checked for wear, pulleys are lubricated and baskets are or painted with brushes. Drip or spills may occur during painting and lubricating the facilities. Where cables enter structures, debris, and animal nesting material is removed. These activities will occur at the RSFS's relief panel pulley system and at the four rakes, which utilize a cable and pulley system for operation.

29. Drainage Improvements (ditches or pipe)
Heavy equipment, including dozers, tractors, backhoes, longsticks, and graders etc. are used to excavate drainage trenches and install drain pipe or to fill low spots to improve drainage. Additionally, trenches and drains are cleared of vegetation and silt with heavy equipment or by hand. Excavated material is piled on levees or rights-of-way, or is transported by truck to an offsite location. Drainage improvements are made as needed, although most occur annually. Work occurs preferentially during dry conditions, usually in the fall, before rains begin. Removal of accumulated vegetation, debris, and soil from existing drains (downdrains, lateral drains, overchutes, or underchutes, etc.) is accomplished by using heavy equipment or by hand.

30. Electrical Repairs by Utility Companies (PG&E, WAPA, or others).
Repairs are made at all utility serviced facilities, as needed, year-round, and primarily at buildings. Repairs to, or replacement of, transformers, power poles, and severed underground utility lines are made occasionally by utility line crews operating from service vehicles. Pole replacement and underground line repair requires soil excavation.

31. Embankment Maintenance (filling washes and gullies).
Fill embankments from the sides of canals or intakes where the canal or intake is higher than the surrounding terrain. Protective and training embankments occur along the uphill side of Rock Slough; the former function to reduce runoff and erosion of soil into the Canal, and the latter to divert water toward underdrains or overchutes. Backhoes, graders, excavators, or hand

implements are employed to fill gullies, burrows, compact soil and grade slopes as needed; however, work occurs primarily during the dry season. Trucks are used to haul fill.

32. Facilities Inspection

All facilities are inspected at least once annually. Mechanical (gates, pumps, etc.) and electrical equipment (communications, monitoring, and computer systems, etc.) is visually examined and operated to test functionality. Inspection may occur from both land and water. Conveyance and storage facilities (i.e., canals, screens, bridges, etc.) and other physical facilities are visually inspected for integrity. The RSFS Facility will be inspected once or twice per year in late winter and/or early spring.

33. Graffiti Removal from Concrete Structures

Graffiti is painted over by hand with a brush or roller, or is removed by sandblasting. Waste materials from sandblasting is collected and disposed of at an appropriate waste disposal site.

34. Guardrail Installation/Repair

Damaged railings and support pillars are removed, repaired, and replaced as needed. Backhoes or other excavators, or shovels are used to excavate and fill pilot holes for support pillars. Vehicle mounted hoists may be used to remove damaged rails or reposition railings. Guardrail locations to be determined in coordination with CCWD project engineer.

35. Valve Rehabilitation

Valve function is checked on pumps and when they do not operate, they are removed and repaired or replaced. Work may be conducted within and/or outside of Reclamation property in both paved and unimproved areas. Valves, if buried, would require excavation with heavy equipment such as a backhoe or front-end loader, etc.

36. Ladders/Safety Nets/Float/Log Boom Repair and Replacement

Ladders, nets, floats, and log booms are inspected at least annually and repaired or replaced when damaged. Disturbance to sites with these features occurs when conducting this work.

37. Pull and Check Pumps

Pumps are checked annually. Pumps enclosed in casings are raised with a hoist or winch, or for smaller units, by hand using a tether. Pump seals, bearings, impellers, motors, and electrical connections are visually inspected or tested and replaced as needed

39. Instrument Recorder House Maintenance (door repair, painting, cleaning, etc.)

RSFSF buildings are swept, and doors are washed and painted by hand with a brush or roller, as necessary.

40. Removal of Trash or Debris

Trash, debris and waste are removed from virtually all of the Project area, including the Canal, debris pits, laydown areas, and drainage channels on an ongoing basis. Small items are collected by hand and disposed of properly. Where needed, trained hazardous waste handlers are enlisted to handle removal and waste disposal. Large debris and trash (including trees, vehicles, refrigerators and other large appliances) in front of the RSFS are removed with the aid of hoists, excavators, work boat, etc. Dried aquatic weeds are removed with the aid of heavy equipment and trucks for transporting off-site when necessary.

41. Rights-of-Way Trash Removal
Tires, plastics, lumber, bedding, scrap metal and other trash and garbage are removed by hand from rights of ways and hauled by truck to appropriate waste disposal site. Larger items such as vehicles and appliances are removed with the aid of service trucks with hoists or winches. Where needed, trained hazardous waste handlers are used to collect and dispose of hazardous wastes

42. SCADA System Repair and Upgrade
SCADA equipment is located at control structures at facilities. Security systems, level transmitters, water quality equipment, and auxiliary systems are all monitored by SCADA. Repair includes removal and replacement of electrical, computer, or communications equipment, primarily modular components or panels.

43. Sign Repair/Replacement/Installation
New signs may be installed, and damaged sign faces or supports are repaired. Faces of signs are repainted or replaced. Pilot holes for support posts are dug with an auger, shovel, or equipment such as a backhoe. Repairs or replacement of signs occurs at most Project facilities, on an as needed basis.

44. Stilling Well Maintenance (pumping/backflush, etc.)
Stilling wells are concrete or metal pipes placed vertically in Rock Slough, both in front and behind the screens. Movement of water into the well permits accurate measurement of the height of water in the Canal. Debris and silt that collects in the connector pipe or the well is backflushed with a pump to clear the system of debris as frequently as monthly at some locales, but more commonly annually, or as needed.

48. Utility Trenching (SCADA/power/misc.)
Work is done with a trencher, backhoe or excavator to lay underground utilities to facilities and upgrade the systems in place. Most utility infrastructure has been provided and the need for trenching is infrequent.

49. Wash and Paint Turnouts and Check Structures (includes Headworks/Flood Isolation and RSFS Structures)
Structures are pressure washed with water or cleaned with a wire brush and painted with rollers or brushes using epoxy paint during dewatering. CCWD proposes to paint certain structures (e.g., the Headworks Structure and the underside of the RSFS) with nesting bird-deterrent coating to prevent birds from nesting on structures. Structures are generally washed annually and painted either annually or as needed. Accidental spill of paint could contaminate waterways.

50. Wash Bridges and Fish Screens
Dirt is removed from bridges, railings, and the RSFS screen panels with a portable pressure washer using water. Bridges, such as the one at the Headworks Structure, and the RSFS are washed annually. Railings on bridges are hand or spray painted after being washed.

53. Canal Desilting Operations
Desilting is done at turnouts, wasteways, and in the canals or their lateral drains. Suction cleaning and desilting is planned along the concrete apron in front of and behind the screens at the RSFS. Desilting is done as needed; as frequently as monthly or infrequently as canals are dewatered on main canals. Silt is flushed by opening gates or checks at wasteways and turnouts to remove sediment. Additionally, heavy equipment such as a longstick, draglines, or backhoes also may be used to physically remove accumulated sediments from the bottoms of canals or basins. Flushed sediment may be washed further down conveyance. Accumulated sediment may be piled on a canal bank adjacent to the facility, be loaded in a truck and transported to either temporary or permanent spoil piles, or be hauled to a site where it is used as fill. Sediment spoil piles may or may not be seeded to prevent erosion.

54. Minor Road Construction/Rehabilitation
Road rehabilitation or construction is done to provide new access to facilities or to recondition existing roads along and around the RSFS Facility. It can involve ripping and removal of existing asphalt, regrading of roadbed, compaction of the new bed and underlying soil. Sand is spread by truck, along with crushed rock, and new asphalt that is compressed. Road construction is done irregularly or on a limited scale annually. When needed, major road construction/ rehabilitation would be addressed under separate environmental review.

57. Structure Construction (blockhouses, stilling wells etc.)
Structures are constructed on an as-needed basis when new operational facilities are added. Sites are graded and forms set for pouring concrete pads. Framing may use concrete block, metal, or wood with metal siding. Trenching may be done to provide underground utilities to the site.

58. Utility and Facilities Repair
These repair activities include irregularly implemented minor repairs. Major repairs are done after completing separate environmental review. Utility companies may send service vehicle(s) to repair electrical connections or replace transformers. There is a limited chance for impacts to listed species when repairs require soil disturbance. Repairs may occur anywhere along the RSFS Facility but are primarily conducted inside structures. The entire area was filled in 2011; any future trenching would occur in non-native soil.

Table 10 provides a subset of expected maintenance activities at the RSFS that are covered by the 2005 USFWS BiOp. The actual maintenance activities may vary and differ from the above list and will be limited by the 41 proposed maintenance activities within the 2005 USFWS BiOp that are proposed for the RSFS Facility.

Table 10 Common Maintenance Activities at the RSFS and Listed Species Potentially Affected

Maintenance Activity (Reference from USFWS 2005 BiOp)	Location (Water and/or Land)	Duration & Frequency	Season/Timing of Activity	Protected Biota Potentially Affected
In-water inspection (#32)	In front of and behind RSFS (water)	Once or twice per year	Late winter, early spring	Listed fish and giant garter snake

Maintenance Activity (Reference from USFWS 2005 BiOp)	Location (Water and/or Land)	Duration & Frequency	Season/Timing of Activity	Protected Biota Potentially Affected
Log boom maintenance (#36)	Area in front of RSFS (water and land)	As required, expect 1 to 2 times per year	Anytime	Listed fish and giant garter snake
Application of coatings, netting or spikes (#49)	RSFS Structure, buildings and equipment (over water and land)	As required	Spring through fall during warm weather	None
Installation of survey monuments, trenching and fenceposts (#23)	RSFS (land area and deck)	As required	Anytime	Giant garter snake
Aquatic weed contact herbicide application (spraying) (#1)	In front of and behind the screened facility (water)	One week to complete activity each occurrence, will include spot treatments at regular time intervals	June through October	Listed fish and giant garter snake
Mechanical removal of aquatic weeds (#13)	In front of and behind the screened facility (water)	Up to two weeks to complete activity each occurrence, expected to be used for larger vegetation removal efforts	June through October	Listed fish and giant garter snake
Pressure wash fish screens and bridges (#24, #50)	On bridge deck (over water)	As needed, but anticipated not more than twice per year	As needed	Listed fish and giant garter snake
Silt removal (#53)	In front of and behind the fish screens (water).	As needed, but anticipated once per five (5) years.	Jul–Oct	Listed fish and giant garter snake
Discing and mowing rights-of-way, contact terrestrial and pre-emergent herbicides, hand and mechanical control of terrestrial vegetation, removal of trash (#2, #3, #8, #13, #16, #19, #40, #41)	Within ROW, unpaved areas (land)	Three weeks to complete discing and mowing each occurrence; up to two occurrences per year. As needed for other activities	Mar–Oct for discing and mowing	Giant garter snake
Mechanical rake maintenance including rake head, wire ropes,	RSFS (deck and over water)	As needed but expected one to two times per	Any time of the year	Listed fish and giant garter snake

Maintenance Activity (Reference from USFWS 2005 BiOp)	Location (Water and/or Land)	Duration & Frequency	Season/Timing of Activity	Protected Biota Potentially Affected
and hydraulic and debris handling systems (#25, #58)		year.		
Squirrel baiting (#22)	In ROW, on levees, embankments, around buildings (land)	As needed	As needed	Giant garter snake

2.2.4 Land Acquisition and/or Land Use Authorizations

There are land acquisition and/or land use authorization activities that Reclamation may implement as part of this Project that will have no effect on listed species as they are administrative in nature (e.g. transferring of land from CCWD to Reclamation, from Reclamation to private landowners etc.) and are therefore not discussed further. Those activities associated with land acquisition and/or land use authorizations that may affect listed species are described below:

Irrigation System Improvements

As described in Section 2.2.1, there are several irrigation system improvements proposed to fix ongoing issues with existing infrastructure (see Figure 14). Reclamation will provide land use authorization for the improvements as well as landowner access for ongoing O&M of the irrigation facility. Ongoing O&M of the existing pipelines will continue to be done in this area by the owners of the pipelines which may involve removing dirt around the pipelines for access as well as working within the afterbay area behind the RSFS.

Land Encroachment Repairs

The northwestern fence boundary originally installed for the RSFS Facility was placed 50 feet beyond the actual RSFS Facility property line (referred to as "Encroachment Area" in Figure 2 and 14). The area east of the northwestern fence (approximately 500 feet by 85 feet, or approximately one acre) was covered with approximately 10 feet of soil to form a debris drying area and has been kept free of vegetation (referred to as "Aquatic Weed Drying Area" in Figure 2). There is also a jurisdictional ditch (USACE Permit Number: SPK-2009-00600, Sacramento District Office) located in an area approximately 5 to 12 feet west of the northwestern fence that terminates into an 18-inch concrete culvert that extends through the northern berm to drain into the Rock Slough Extension. The ditch has not performed as intended and much of the ditch has filled in with sediment. In addition, the area around the ditch has transformed into a wetland area due to poor drainage.

Reclamation is in ongoing negotiations with the landowner to resolve the encroachment. Possibilities for resolution include leaving the fence where it is or moving the fence to its correct alignment. If the fence was left in place property utilization is expected to remain the same. If the fence is moved to its correct alignment the following would be required (see Figure 20 for proposed locations):

- Restoration of the encroached areas to RSFS Facility pre-construction conditions. This would entail removing and re-contouring an embankment by moving it back 50 feet from the current location of the fence line to the correct RSFS Facility boundary. This would require removing about 10,000 CY of material and shifting 500 linear feet of fence. Approximately 2,777 square yards of the earth beneath the existing embankment would need to be restored. This may include reseeding and/or planting vegetation in addition to earth contouring work. The approximate 10,000 CY of spoil may be spread on the adjoining property owner lands or Reclamation lands, likely within the unlined portion of the Canal or on a portion of the RSFS Facility property to expand the drying area.
- The jurisdictional ditch would be reconstructed to drain the adjoining RSFS Facility property and the area around the ditch would be reconstructed so that it drains better. The adjoining property, where the ditch was initially constructed, may need improved grading as absent such grading it is subject to ponding. A portion of the fill material to be removed may be used for this grading. Approximately one-half acre of wetlands has been identified in this area. This may also be done even if the fence is not moved.
- The culvert located west of the northwestern fence at the base of the earthen berm may also need to be relocated to the area along the new fence line and a corresponding drainage ditch would be installed to connect the toe drain from the unlined Canal to the Rock Slough Extension. The new 500-foot drainage ditch may be constructed approximately 7 feet from the correct property line and an 18-inch diameter culvert may be installed through the berm to drain this ditch into the Rock Slough Extension. The earthen berm dimensions are approximately a 2 foot crest with 5 feet for the banks on either side, for a total area of 12 feet. The estimated area of restoration and reconstruction for the encroachment property may be as large as 1.85 acres. Installation of the new culvert will require placement of a U-shaped 40-foot long coffer dam around the culvert within the Rock Slough Extension.

Construction of these improvements is anticipated to be from July 1 through October 31.

WAPA Access Road Easements

Reclamation would acquire three existing access road easements purchased by CCWD in 2009 with Reclamation funding. These would then be transferred to WAPA to facilitate ongoing maintenance of the existing 69 kV power lines that are used by CCWD for Pumping Plants 1-4 on the Canal.

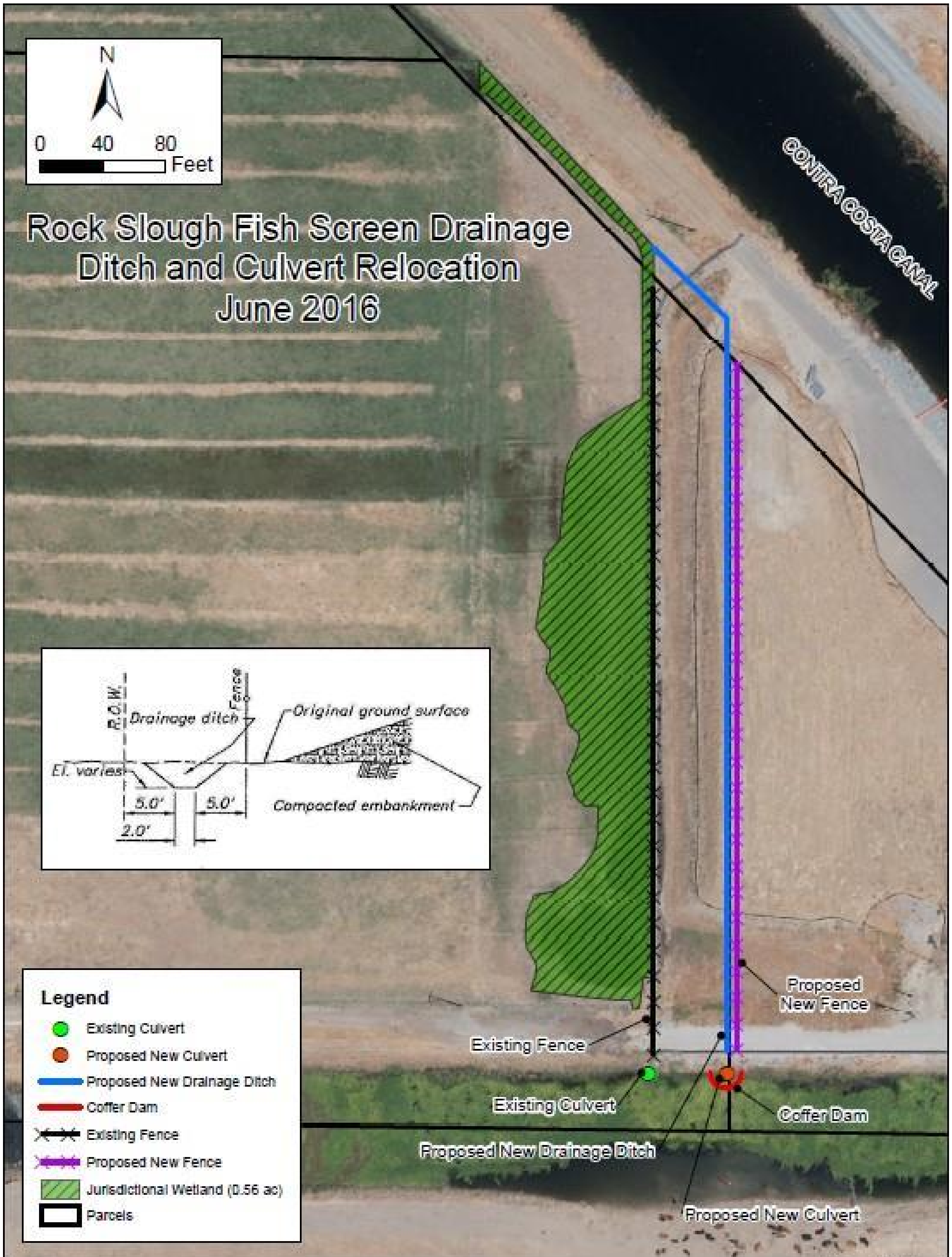

Figure 20 RSFS Proposed Drainage Ditch and Culvert Relocation

2.3 Action Area

The Action Area is defined as all the areas that could be directly or indirectly affected by the proposed Project. The Action Area includes the levee roads and banks of the Canal on both sides up to Cypress Road where various maintenance activities take place that are under the 2005 USFWS BiOp (see Figure 2). The Action Area also includes the land area within the boundary of the RSFS Facility as well as the RSFS afterbay, Headworks Structure, and the Flood Isolation Structure.

Maintenance activities will occur at the RSFS and at the land and water areas around the RSFS Facility. The Headworks Structure and the Flood Isolation Structure are within the existing location of the Canal, and maintenance activities in these areas are covered by the 2005 USFWS BiOp.

Aquatic weed management will occur in the RSFS afterbay. The land area within the RSFS Facility boundary contains the aquatic weed drying area, the permanent anchors for the relocated log boom, and the land required for construction of both boat ramps. The on-land Action Area outside the RSFS Facility boundary includes one small area that is scheduled to have improvements made to an irrigation system that is on private land northeast of the RSFS (see Figure 2), the temporary/permanent anchors for the log boom that will be anchored on the southern side of Rock Slough, and two access roads (one on the north side of the Rock Slough Extension and the other on the south side of Rock Slough from the Extension to the southern log boom anchor area). In addition, there is an area that may be up to 50 feet west of the existing property line fence (outside of the land encroachment property) that may be restored. Excavated fill associated with the movement of the drying area berm is expected to be placed within the unlined Canal right of way.

The Action Area within Rock Slough itself extends from the Rock Slough Extension to approximately 200 feet upstream of the relocated log boom. Mechanical harvesting will occur from the Rock Slough Extension to approximately 200 feet beyond the relocated log boom (or up to approximately 800 feet east of the RSFS), and aquatic herbicide application will occur from the Extension to the relocated log boom. The Project's Action Area is shown in Figure 2.

2.4 Avoidance, Minimization, and Mitigation Measures

This subsection describes the avoidance and minimization measures that Reclamation and CCWD will implement to avoid and/or minimize potential effects from the proposed Project to the species addressed in this BA.

The RSFS Project has already mitigated for 0.2 acre of benthic habitat loss in Rock Slough by purchasing 0.3 acre at Kimball Island Mitigation Bank and 30.5 acres at the Big Break shoreline.

The following general avoidance and minimization measures for listed species and their habitats will be incorporated:

- Movement of heavy equipment to and from the Project site will be restricted to established roadways (including levee roads), when possible, to minimize disturbance.
- After completion of construction activities, any temporary fill and construction debris will be removed, and wherever feasible, disturbed areas will be restored to pre-Project conditions.
- All fueling and maintenance of vehicles or other equipment and staging areas shall occur at least 150 feet from any waterbody. CCWD will ensure that contamination of potential habitat does not occur during such operations. Prior to the onset of work, CCWD will ensure that contractors have prepared a plan to allow prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and the appropriate measures to implement should a spill occur.
- Waste will be placed in containers to be removed at the end of each working day. If it is not possible to dispose of trash off-site every day, all trash and debris will be collected and placed in tightly sealed containers on-site that are emptied at least once per week at an appropriate off-site location.
- Wetland impacts are estimated to be approximate 0.5 acre of permanent impacts while temporary impacts are expected to be minimal. All temporary wetland impacts will be restored within one year.

The following general avoidance and minimization measures for the giant garter snake will be incorporated into the project description:

- If impacts to giant garter snake habitat as a result of covered activities cannot be avoided, minimization measures based on USFWS's Avoidance and Minimization Measures during Construction Activities in Giant Garter Snake Habitat (USFWS 1999) will be implemented, including the following:

    - Before any ground-disturbing construction activities begin, CCWD will retain a qualified biologist, approved by USFWS, to conduct focused surveys for the giant garter snake to confirm there are no giant garter snakes present in the Action Area where ground-disturbing construction activities will begin. A preconstruction survey will be conducted by a USFWS-approved biologist within 24 hours before the start of construction in any portion of the Project site slated for ground-disturbing activities. Fossorial mammal burrows will be flagged and avoided if possible. Preconstruction surveys will be reinitiated if construction adjacent to aquatic features is suspended for two or more weeks and then restarted. If giant garter snakes are present, they will be allowed to move away from construction activities on their own. Surveys must be conducted every year in which construction activities occur. A giant garter snake letter report documenting survey methods and findings will be submitted to USFWS.
    - A USFWS-approved biologist will provide giant garter snake environmental awareness training to all CCWD employees and contractors who work on activities that could affect giant garter snake (see Section 2.4.5 for a description of the training).

Additional specific avoidance and minimization measures for each of the Project components are described below.

2.4.1 RSFS Improvements

The proposed avoidance and minimization measures for the RSFS Improvements include the following:

Rake Improvements

- Monitoring of the modified rakes for signs that surrogate species (e.g., fall-run Chinook) are being entrapped at lower rates than those at non-modified rakes.

Platform Extension

- The platform extension will be grated to minimize shading and therefore any potential of attracting listed species to the face of the screens and subject them to potential take.

Boat Ramp Construction

- All in-water work will be conducted from July 1 through September 30 during the giant garter snakes' active period and when listed fish species are not likely to be present in the vicinity of the RSFS and a 31-day period in October during the snakes' inactive period;
- If activities take place during the snakes' active period a USFWS-approved biologist will conduct pre-construction in-water giant garter snake surveys;
- A USFWS-approved biologist will conduct giant garter snake pre-construction surveys on land, and mark any fossorial mammal burrows for avoidance, if possible. If present, photographs of the snake will be taken and USFWS will be notified within 24 hours of a sighting. If giant garter snake is found in the work area during Project activities, work that could affect the snake(s) will cease, and USFWS will be notified within 24 hours.
- During construction a silt curtain will be used to minimize increases in turbidity and to keep fish and giant garter snake(s) out of the construction area. The silt curtain will be removed on incoming tide so that suspended sediments enter the RSFS afterbay rather than entering Rock Slough;
- Boats, equipment, and vehicles will be operated carefully at slow speeds.
- Boat(s) will be refueled out of the water and over paved areas.

Log Boom Relocation and Maintenance

- A USFWS-approved biologist will conduct pre-construction surveys on land for giant garter snake, mark any fossorial mammal burrows for avoidance if possible. If present, photographs of the snake will be taken if possible, and USFWS will be notified within 24 hours of a sighting. If giant garter snake is found in the work area during Project activities, work that could affect the snake(s) will cease, and USFWS will be notified within 24 hours.
- If the log boom is relocated during the snake's active period, a USFWS-approved biologist will conduct an in-water giant garter snake survey prior to relocation;
- If ecology blocks are moved or when a permanent anchoring system is installed a USFWS-approved biologist will conduct a survey on land using, mark any fossorial mammal burrows for avoidance if possible;
- Boats, equipment, and vehicles will be operated carefully at slow speeds.

Irrigation System Improvements

- If possible, all in-water work will be conducted from July 1 through September 30 during the giant garter snakes' active period and when listed fish species are not likely to be present in the vicinity of the RSFS and a 31-day period in October during the snakes' inactive period;
- A USFWS-approved biologist will conduct pre-construction surveys on land for giant garter snake, mark any fossorial mammal burrows for avoidance if possible. If present, photographs of the snake will be taken if possible, and USFWS will be notified within 24 hours of a sighting. If giant garter snake is found in the work area during Project activities, work that could affect the snake(s) will cease, and USFWS will be notified within 24 hours.
- If activities takes place during the giant garter snake active period a USFWS-approved biologist will conduct in-water surveys.

Construction Access

- Dust abatement actions will be taken;
- Equipment and vehicles will be operated carefully at slow speeds

Staging Areas & Parking

- Prior to initiating construction and/or maintenance activities, a spill prevention plan will be prepared and implemented to ensure prompt and effective response to any accidental spills;
- Vehicles or other equipment will be fueled and maintained at least 150 feet from any water body and measures will be implemented to ensure that contamination of potential habitat does not occur during such operations;
- Spill containment equipment will be provided and all contractors will be made aware of its location;
- Vehicles or other equipment will be fueled and maintained at least 150 feet from any water body and measures will be implemented to ensure that contamination of potential habitat does not occur during such operations;
- Vehicles and heavy equipment moving to and from the will be restricted to established roadways (including levee roads), when possible;
- Equipment and vehicles will be operated carefully at slow speeds.

2.4.2 Ongoing Operation of the RSFS Rakes

Avoidance and minimization measures for ongoing operation of the RSFS rakes are described by activity below.

Rake Operations

- Rakes will be operated considering the potential for listed salmonids presence (from November through April)
- If salmonids are present the rakes will be operated on flood tides or using the "brush only" mode, if possible;
- With the objective of maintaining uniform approach velocities, the rake mechanism cycle timer will be adjusted based on screen differentials;

- Use of the log boom, mechanical harvesting, or aquatic herbicide applications will be implemented to reduce invasive aquatic weeds that can compromise the effectiveness of the rakes;
- Improvement to the hydraulic system will be implemented to reduce chance of accidental spills.
- If salmonids and or other listed fish species are found in the debris, CCWD may operate the rakes based on tidal conditions (ebb tides seem to attract salmon to the screen).

Debris Management

- Equipment and vehicles will be operated carefully at slow speeds
- Prior to the placement of debris into the drying area, observations for the presence of snakes (including giant garter snakes) will be conducted. If a snake is present it will be allowed to leave on its own prior to debris being deposited;
- Rodent populations will be controlled in areas where debris will be spread to minimize attractive habitats where heavily disturbance occurs and take risks could increase.

Debris Monitoring

- Fish monitoring data, intake forebay observations, and debris monitoring data will be assessed to determine if listed species are present. Debris monitoring efforts will be increased if listed species are present.

Note: In the long-term, the likelihood of impacting listed species at RSFS is expected to decrease significantly as the Canal is encased in a pipeline. This project is being conducted as a separate action by CCWD and has undergone separate environmental review. This ongoing, multi-phased project will result in tidal flows being significantly reduced at the RSFS. NMFS has advised that salmonids will likely be less attracted to the RSFS if tides can be reduced. Figure 21 shows modeling of tidal flows at the RSFS that demonstrates the effectiveness Canal encasement to attenuate the tides. CCWD expects to have sufficient funds to complete the encasement project by 2020, assuming receipt of California Department of Water Resources (DWR) grant funding and developer funding.

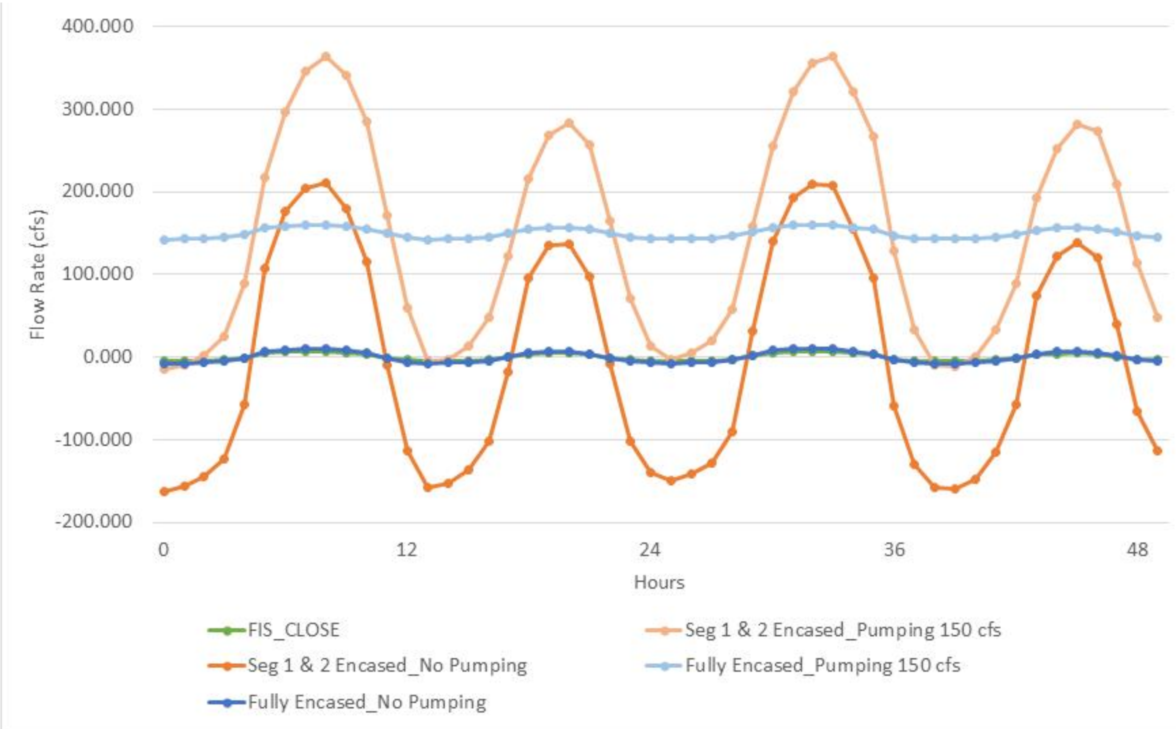

Figure 21 Modeled tidal flow at the RSFS for five conditions: 1) existing Canal with no pumping (dark orange line); 2) existing Canal pumping 150 cfs (light orange line); 3) the Flood Isolation Structure (FIS) closed (green line); 4) the Canal fully encased in a pipeline (dark blue line); and 5) Canal fully encased pumping 150 cfs (light blue line).

2.4.3 Ongoing O&M Activities

Avoidance and minimization measures for land-based O&M activities include:

- CCWD will notify all ranchers that access their irrigation pumps the various environmental conditions and measures at the site. Note: Although notified, ranchers using the RSFS Facility property may impact listed species. CCWD will inform Reclamation and the various appropriate agencies should it become aware of effects from the ranchers onsite activities.
- If work is scheduled to occur during the snake's inactive period and there is a possibility that the snake could be present in the work area, a USFWS-approved biologist will conduct pre-construction/disturbance surveys (i.e., blading and discing of rights-of-way and blading of O&M roads). Note: Fossorial mammal burrows, that could contain giant garter snake, will be marked and avoided if possible during work activities. If present, photographs of the snake will be taken and USFWS will be notified within 24 hours of a sighting. If giant garter snake is found in the work area during Project activities, work that could affect the snake(s) will cease, and USFWS will be notified within 24 hours.
- All CCWD employees and contractors will strictly adhere to posted speed limits (15 mph on access roads, less while operating heavy equipment) and will carefully observe the road for snakes.
- Dust abatement will occur during O&M activities when required.
- All terrestrial contact herbicides, pre-emergent herbicides, squirrel baiting, and insecticides will be applied at labeled rates and will follow the requirements of CCWD's

approved IPMP (Appendix B), or updates, and Reclamation's requirements (i.e., Reclamation Manual Env. 01-01).

- The deposition of mechanically harvested material will be limited to the designated area.
- CCWD, if conducting re-vegetation activities will use native, non-weedy species, if possible.
- All CCWD employees and contractors conducting work where spills are possible will practice good housekeeping practices and will have access to containment booms and cleanup supplies.

Avoidance and minimization measures for O&M activities that occur in or over water include:

- All aquatic herbicides will be applied based on labeled rates and will follow the requirements of CCWD's approved IPMP (Appendix B), or updates, and Reclamation's requirements (i.e., Reclamation Manual Env. 01-01); herbicides will be applied on an incoming tide if possible; California Division of Boating and Waterways (CDBW) will be notified to ensure they are not applying herbicides in the same area. To determine if herbicides can be applied in June and July CCWD will continue ichthyoplankton monitoring three times per week and will use the fish monitoring data and data from CDFW's 20-mm and Summer Townet surveys (see Section 5.2.3).
- Within 24 hours, prior to initiation of aquatic herbicide application or mechanical harvesting a USFWS-approved biologist will conduct pre-application/harvesting surveys for giant garter snake. If a snake is detected, work will not commence until the snake leaves the work area on its own, Reclamation and USFWS will be notified within 24 hours.
- A USFWS-approved biologist will conduct biological monitoring during mechanical harvesting. If a snake is detected, work will not commence until the snake leaves the work area on its own.
- CCWD will coordinate mechanical harvesting and herbicide applications with CDBW.
- Boat speeds will be limited to less than 5 mph.
- Prior to conducting mechanical harvesting CCWD will check its most recent fish monitoring data to ensure that no listed fish species have been seen in the area. If listed species are detected, mechanical harvesting will be delayed until the species is no longer found.
- Desilting will be conducted during the listed fish in-water work window (August 1 through October 31). If possible, desilting will be conducted during a flood tide. A silt curtain will be used if work must be conducted outside the work window.
- If canal dewatering occurs during the snake's active period (May 1–October 1) a pre-dewatering surveys for giant garter snake will be conducted by a USFWS-approved biologist. The area will then be inspected prior to flooding.
- The removal and replacement of bridge or structure support pillars will be conducted from August 1 through October 31 when listed fish are not likely to be present. If work needs to be conducted outside of work window, a silt curtain will be used and the work will occur during incoming tide.

2.4.4 Land Area Encroachment

Avoidance and minimization measures for the land encroachment area include:

- Effects to giant garter snake may be avoided by conducting this activity during the period when giant garter snake would be active and in the aquatic habitat, and away from this area during restoration.

2.4.5 Environmental Awareness Training Program and Survey Protocol

A USFWS-approved biologist will conduct giant garter snake awareness training for employees. The training will be provided in a language other than English if required. The training will include instruction regarding giant garter snake identification, natural history, habitat protection needs, and conservation measures to be implemented on site. Color photographs of the snake will be distributed during the training session and will be posted on site.

2.4.6 Good Housekeeping Practices

Good housekeeping practices will be followed in all work areas. CCWD will ensure that it or its contractors supply closeable trash containers, frequently remove and replace of all trash containers to ensure that adequate empty containers are on site at all times, store materials a sufficient distance away from the Canal or Rock Slough to prevent accidental releases from reaching the water, and make available containment booms in order to minimize the effects of project activities on listed species.

Section 3 Status of the Species and Critical Habitat in the Action Area

Reclamation has determined that seven species that are listed under ESA as either endangered, threatened, or proposed for listing under ESA are potentially present within the vicinity of the Project. These species include the following:

1. Sacramento River winter-run Chinook salmon ESU,
2. Central Valley spring-run Chinook salmon ESU,
3. Central Valley steelhead DPS,
4. Southern DPS of the North American green sturgeon,
5. Delta smelt and critical habitat,
6. Giant garter snake, and
7. Longfin smelt.

This section provides information on the general environmental setting and information regarding the presence of listed species near the Project Area. It discusses the status of the species listed above under the ESA. The population trends, life history, and factors affecting abundance of these species are discussed. This section also discusses the species' critical habitat and recovery plans, where applicable.

3.1 General Environmental Setting of the Project Area

The San Francisco Bay and Sacramento-San Joaquin Delta combine to form the largest estuary along the U.S. Pacific Coast; this estuary is referred to as the San Francisco Bay-Delta Estuary. The Project is located in the northeastern-most portion of the San Francisco Bay-Delta Estuary in the Sacramento-San Joaquin Delta.

The principal water bodies near the Project Area include Rock Slough, Dutch Slough, and Sand Mound Slough. Big Break, a large embayment formed when a reclaimed and subsided agricultural "island" flooded after a levee failure in 1928, is located north of the Project Area and provides connectivity to the San Joaquin River. All of these water bodies are tidally influenced. The area near where the Project is located historically supported a healthy aquatic ecosystem, but its habitat value for listed species such as those evaluated in this BA (longfin smelt, delta smelt, Chinook salmon, steelhead, and green sturgeon) is considered greatly reduced from historic conditions. Several factors are thought to contribute to the decline in the health of the habitat, including the potential for direct loss resulting from entrainment into the south Delta SWP and CVP pumping facilities, adverse water quality conditions, and increased predation by non-native predator species (e.g., striped bass *Morone saxitilis* and largemouth bass *Micropterus salmoides*) (Baxter et al. 2007). The increase in the abundance of largemouth bass, as shown by the salvage data at the CVP and SWP pumps, occurred at the same time as the increase in the range of the invasive submerged macrophyte Brazilian elodea (Brown and Michniuk 2007). Additionally, the area in the vicinity of the Project has the warmest water and highest water clarity.

In the vicinity of the Project, low-salinity water, invasive aquatic plants (Brazilian elodea), and other factors have resulted in increased numbers of non-native predators, most important of which are striped bass and largemouth bass. Nobriga and Feyrer (2007) report that largemouth bass have a more limited distribution in the Delta than striped bass, although their per capita impact on prey species, which include juvenile salmonids, is higher. Brazilian elodea appears to provide habitat for largemouth bass as well as their prey, and its areal coverage in the Delta increased more than 10% per year from 2004 to 2006 (Baxter et al. 2007). Although Chinook salmon fry and smolts can be found in the Delta, survival of fry rearing in the Delta and smolts migrating through the Delta appear to be lower compared to fry that rear in tributary streams and smolts that migrate directly along the Sacramento or San Joaquin rivers (Brown 2003). However, juvenile fish that are able to swim actively against a current may avoid this area of higher predator abundance when the low salinity zone (LSZ) is located in the central Delta region. USFWS (2008) found that young fish associated with the LSZ become vulnerable to high predation rates. Aside from increasing the habitat area for predators, the large expanse of Brazilian elodea may have other negative impacts on vulnerable species. It can overwhelm littoral habitats where delta smelt may otherwise spawn, and it also appears to contribute to the recent reduction in turbidity of the central and south Delta regions by reducing flow velocity (Brown 2003) and mechanically filtering the water column (Nobriga et al. 2005). The resulting increased water clarity has negative effects on delta smelt by increasing their susceptibility to predation and delaying their feeding response (USFWS 2008b).

Delta smelt and salmonids are expected to avoid the area of RSFS during certain times of the year based on historical water temperatures. Water temperatures in Rock Slough, particularly near the RSFS, are generally warmer than those preferred by delta smelt and salmonids. Water temperatures are regularly recorded along with electrical conductivity every 15 minutes at the DWR hydrologic station located approximately 0.2 miles (322 m) from the fish screen. The recorded data are gathered and stored for public use at the California Data Exchange Center (CDEC). The CDEC Rock Slough station (RSL), is located upstream of the RSFS (Figure 22) at latitude 37.97631 and longitude -121.63760. Station datum for river stage is recorded in feet referenced to NAVD88. The high water temperature records for November 26, 2012 through October 30, 2015 were used to compute weekly averages of water temperatures recorded at high tide (river stage) (http://cdec.water.ca.gov/cgi-progs/stationInfo?station_id=RSL). River stage data were sorted to identify daily tidal cycles based on the occurrence of two high and two low stages. A weekly average water temperature was computed from the water temperatures recorded at the time of each day's highest stage (high tide). These average high stage water temperatures (Figure 23) were assigned a sequential weekly designation from 1 to 52, with week one starting on January 1 (Table 11). Water temperatures in Rock Slough range from lows of about 45°F in winter (December and January) to over 70°F beginning in May and continuing October. Warmer water temperatures can be tolerated by many non-native predatory fish such as largemouth bass and striped bass.

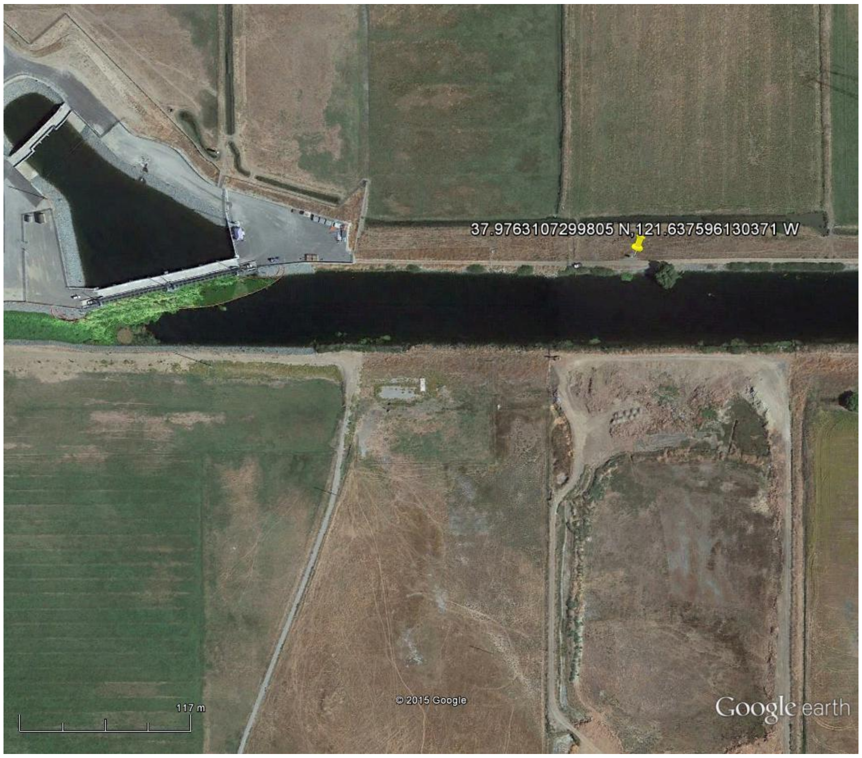

Figure 22 Location of Rock Slough Station RSL. Latitude 37.9763107299805, longitude 121.637596130371, upstream of the RSFS. The RSFS Facility is at the left.

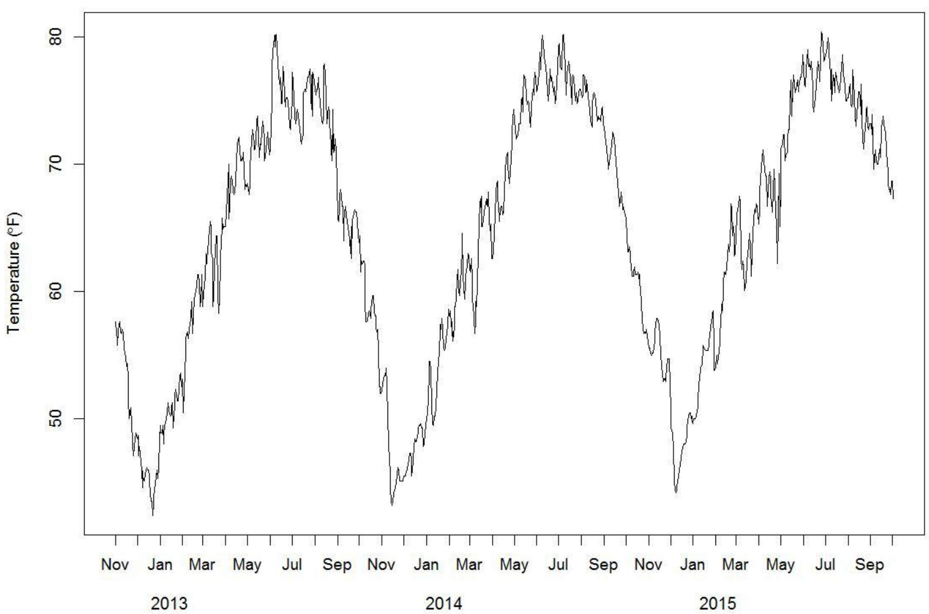

Figure 23 Daily high water temperatures measured in Rock Slough from November 26, 2012 through October 30, 2015[6]

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[6] Based on 15-minute period recordings at Station RSL maintained by the California Department of Water Resources.

Table 11 Weekly averaged high water temperatures at the Rock Slough recording station compiled from data collected from November 26, 2012 through October 30, 2015

Week	Start	End	Temperature	Week	Start	End	Temperature
1	January 01	January 07	45.6	27	July 02	July 08	78.5
2	January 08	January 14	46.8	28	July 09	July 15	76.1
3	January 15	January 21	47.4	29	July 16	July 22	76.4
4	January 22	January 28	49.0	30	July 23	July 29	76.9
5	January 29	February 04	51.0	31	July 30	August 05	76.5
6	February 05	February 11	52.4	32	August 06	August 12	75.5
7	February 12	February 18	54.4	33	August 13	August 19	76.5
8	February 19	February 25	55.4	34	August 20	August 26	75.8
9	February 26	March 04	55.5	35	August 27	September 02	75.9
10	March 05	March 11	59.1	36	September 03	September 09	74.6
11	March 12	March 18	61.1	37	September 10	September 16	74.2
12	March 19	March 25	62.5	38	September 17	September 23	72.8
13	March 26	April 01	62.6	39	September 24	September 30	70.9
14	April 02	April 08	61.8	40	October 01	October 07	68.8
15	April 09	April 15	64.0	41	October 08	October 14	69.5
16	April 16	April 22	64.6	42	October 15	October 21	67.6
17	April 23	April 29	65.7	43	October 22	October 28	65.9
18	April 30	May 06	68.5	44	October 29	November 04	62.7
19	May 07	May 13	68.2	45	November 05	November 11	59.9
20	May 14	May 20	69.3	46	November 12	November 18	59.2
21	May 21	May 27	69.5	47	November 19	November 25	55.3
22	May 28	June 03	71.5	48	November 26	December 02	55.1
23	June 04	June 10	73.8	49	December 03	December 09	53.6
24	June 11	June 17	74.2	50	December 10	December 16	51.3
25	June 18	June 24	74.6	51	December 17	December 23	49.1
26	June 25	July 01	76.5	52	December 24	December 31	47.9

3.1.1 Summary of Fish in the Vicinity of the Project

In order to characterize the juvenile and adult life stages of fish near the proposed Project, 11 years of fishery data collected as part of CCWD's Fish Monitoring Program at the Rock Slough Intake were reviewed. Also reviewed were data collected by CDFW at six stations in the vicinity of the RSFS Facility during the Smelt Larva Survey (2009–2015), 20-mm Survey (2007–2015), and the Summer Townet Survey (2007–2015) to characterize the earlier life stages of Delta and longfin smelts in the vicinity of the Proposed Project.

Contra Costa Water District Rock Slough Fish Monitoring

CCWD sieve net monitoring data (1999 – 2009) was reviewed to characterize the juvenile and adult fish community in Rock Slough. The data examined were collected at the Rock Slough Headworks prior to the completion of the RSFS. Sieve net sampling was conducted by deploying a 1,600-micron mesh net for a period of three hours per survey. During the listed fish season (January through June), typically three surveys were conducted each week. During the remainder of the year (July through December), generally one survey was conducted each week. Results of our analysis showed that 96% of the total number of fish collected were introduced species (Table 12). Over 500 sieve net samples were collected from 2003–2009; there are no records listing the number of surveys conducted prior to 2003. Non-native predatory fish (bluegill *Lepomis macrochirus*, largemouth bass, striped bass, redear sunfish *Lepomis microlophus*, and white catfish *Ictalurus catus*) comprised approximately 58% (n=4955) of the total number of fish collected during the 11-year study. Listed species (Central Valley steelhead, spring-run Chinook salmon, and delta smelt) comprised approximately 0.3% (n=27) of the total number of fish collected during the 11-year study. No winter-run Chinook salmon, green sturgeon, or longfin smelt were conducted during the 11-year study. A summary of the collection of listed species collected during the study is shown in Table 13.

Table 12 Total number of fish collected by sieve net from 1999–2009 at the Rock Slough Headworks prior to construction of the Rock Slough Fish Screen

Species	Total Number Collected	Percent Composition
Threadfin shad	2,632	30.32
Bluegill	2,579	29.71
Largemouth bass	1,258	14.49
Redear sunfish	532	6.13
Mississippi silverside	468	5.39
White catfish	343	3.95
Splittail	263	3.03
Striped bass	243	2.80
Channel catfish	53	0.61
Yellowfin goby	53	0.61
Rainwater killifish	44	0.51
American shad	42	0.48
Prickly sculpin	25	0.29
Chinook salmon (fall run)	18	0.21
Black crappie	16	0.18
Central Valley steelhead[1]	15	0.17
Western mosquitofish	14	0.16
Chinook salmon (spring run)[1]	11	0.13
Shimofuri goby	11	0.13
Brown bullhead	8	0.09
Centrarchidae	8	0.09
Golden shiner	8	0.09
Common carp	7	0.08
Lepomis spp.	7	0.08
Goldfish	4	0.05
Green sunfish	4	0.05

Species	Total Number Collected	Percent Composition
Chinook salmon (run not specified)	3	0.03
Clupeidae	3	0.03
Black bullhead	2	0.02
Tridentiger spp. gobies	2	0.02
Bigscale logperch	1	0.01
Delta smelt[1]	1	0.01
Pacific lamprey	1	0.01
Pacific staghorn sculpin	1	0.01
White crappie	1	0.01
Total	**8,681**	**100.00**

Source: CCWD 2015.
Note shading indicates native species.
[1]Listed species under ESA.

Table 13 Total number of listed species collected by sieve net from 1999–2009 at the Rock Slough Headworks prior to construction of the Rock Slough Fish Screen

Species	Total Number of Listed Species Collected	Year Collected–Month Collected–Total Number Collected by Year
Winter-run Chinook salmon	0	N/A
Spring-run Chinook salmon	11	2004–Mar, Apr–3 total 2005–May–4 total 2006–May–3 total 2008–Feb–1 total
Central Valley steelhead	15	2005–Feb, Mar, Apr–4 total 2006–Jan, Mar–2 total 2007–May–1 total 2008–Feb, Mar–8 total
Green sturgeon	0	N/A
Delta smelt	1	2005–Feb–1 total
Longfin smelt	0	N/A

Source: CCWD 2015.

The abundance of introduced and predatory fish in Rock Slough was further documented during fish rescue/relocation efforts conducted in 2009 prior to construction of the RSFS. The fish rescue resulted in the collection of 4,212 individuals represented by 20 species of fish (Table 14); 98.6% of which were introduced species. The following six fish species comprised almost 95% of the total number fish collected: bluegill (35.7%), redear sunfish (34.6%), white catfish (15.8%), largemouth bass (3.3%), threadfin shad *Dorosoma petenense* (2.5%), and golden shiner *Notemigonus crysoleucas* (2.4%). One steelhead with an intact adipose fin was collected and was immediately transported, measured, and released. Fish length ranged from a 30-mm total length (TL) (1.2 in.) bluegill and redear sunfish to a 622-mm fork length (FL) (24.5 in.) steelhead (Table 14).

Table 14 Number and percent composition of fish collected during CCWD's fish rescue efforts in November 2009 as part of the RSFS Project

Taxon	Common Name	Total Number Collected	Percent of Total Number Collected
Lepomis macrochirus	Bluegill	1,502	35.7
Lepomis microlophus	Redear sunfish	1,457	34.6
Ictalurus catus	White catfish	666	15.8
Micropterus salmoides	Largemouth bass	140	3.3
Dorosoma petenense	Threadfin shad	105	2.5
Notemigonus crysoleucas	Golden shiner	103	2.4
Pomoxis nigromaculatus	Black crappie	61	1.4
Cottus asper	Prickly sculpin	58	1.4
Ameiurus melas	Black bullhead	43	1.0
Morone saxatilis	Striped bass	25	0.6
Ictalurus punctatus	Channel catfish	23	0.5
Lepomis gulosus	Warmouth	8	0.2
Cyprinus carpio	Common carp	7	0.2
Percina macrolepida	Bigscale logperch	6	0.1
Acanthogobius flavimanus	Yellowfin goby	2	<0.1
Menidia beryllina	Mississippi silverside	2	<0.1
Tridentiger bifasciatus	Shimofuri goby	1	<0.1
Oncorhynchus mykiss	Steelhead	1	<0.1
Lepomis cyanellus	Green sunfish	1	<0.1
Carassius auratus	Goldfish	1	<0.1
Total		**4,212**	

Note shading indicates native species.
Source: CCWD 2009.

CCWD Larval Fish Monitoring CCWD's larval fish monitoring program has changed throughout the years. Initiation of CCWD's larval fish monitoring from 2004 – 2010 was based on information received from CDFW regarding the presence of delta smelt in the vicinity of CCWD's south Delta intakes. Larval fish monitoring during these years always terminated on June 30. From 2004 – 2009, larval fish sampling was conducted at the Rock Slough Headworks Structure. A total of three 30-minute larval fish samples were collected each week using a 505-micron mesh plankton net when CCWD was diverting water at Rock Slough. In 2010, larval fish sampling was conducted at PP1 because the Rock Slough Headworks site was not available due to construction of the RSFS. When larval fish sampling occurred at PP1, it was necessary to reduce the sampling time from 30 minutes to 5 minutes due to the damage that occurred to the larval fish from net abrasion as a result of the high velocity of water exiting PP1. No larval fish sampling was conducted in 2011 due to construction of the RSFS, and the agreement that sampling ichthyoplankton at PP1 was not effective. Beginning in January 2012, ichthyoplankton monitoring was increased at the RSFS from three samples per week to nine samples per week.

A new fish monitoring plan was approved by the Resources Agencies in late 2011 for the newly constructed RSFS. Under this plan, CCWD initiates larval fish sampling when the first smelts (either longfin or Delta) are detected in the CDFW Smelt Larva Survey at stations in the south Delta (stations 901, 902, 915, 914, and 918; referred to as "trigger stations"). See Figure 24 for the location of the CDFW sampling stations. Sampling terminates when results from the CDFW 20-mm Survey show that no smelts were collected at the trigger stations during three consecutive surveys. If either longfin or delta smelts are detected at the trigger stations after CCWD ceases larval fish sampling, CCWD reinitiates sampling and follows the guidelines specified above until the 20-mm Survey terminates. If CDFW surveys are not conducted, CCWD initiates sampling in January and continues through June. Larval fish sampling under the new plan increased from three samples per week to nine samples per week.

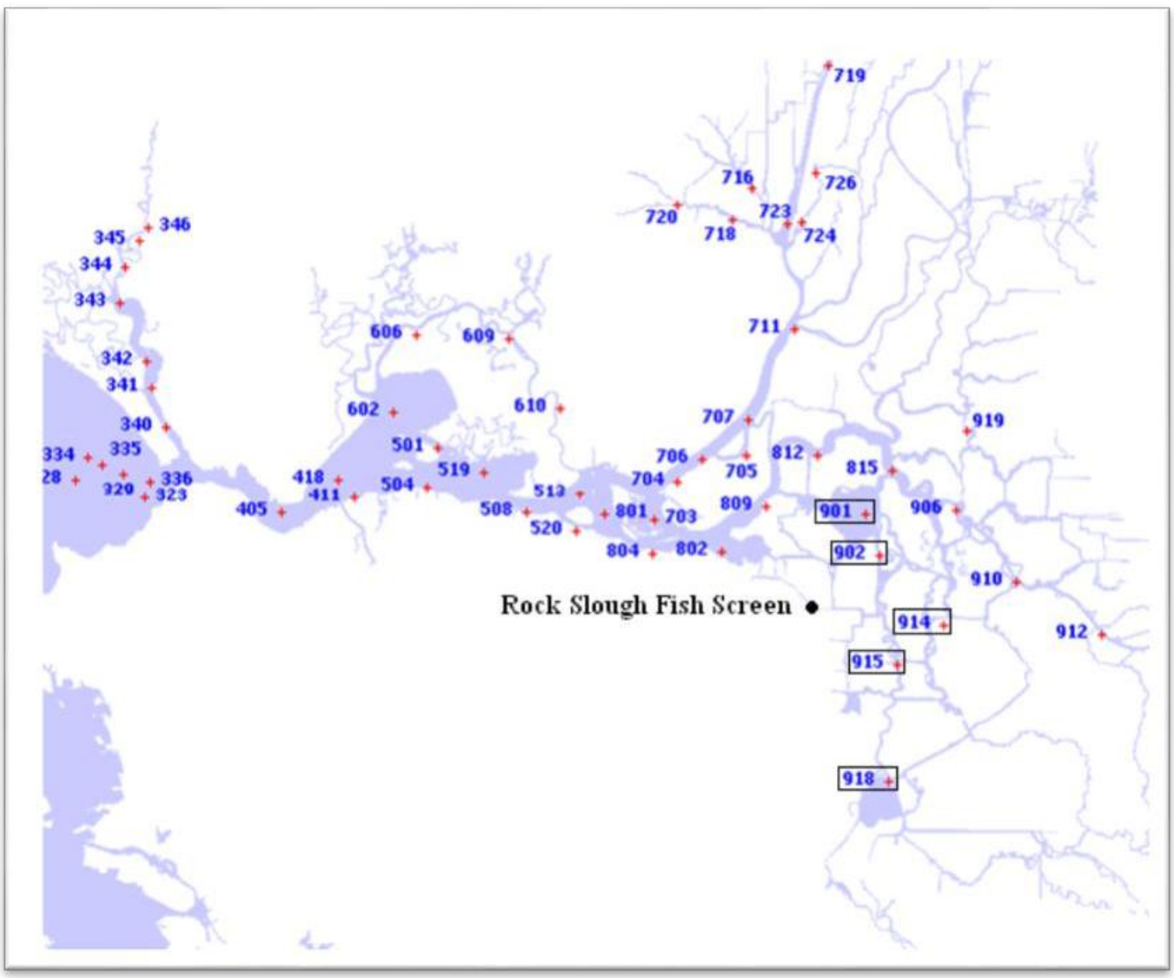


Figure 24 Location of CDFW's monitoring stations showing the location of RSFS and CCWD's "trigger stations" (enclosed in boxes).

A summary of information regarding larval fish sampling at Rock Slough Headworks, PP1, and RSFS is provided in Table 15. A total of 385 ichthyoplankton samples were collected from 2004

– 2015 at the three locations. From 2004 – 2015, only one delta smelt and one longfin smelt have been collected during larval fish sampling at Rock Slough Headworks, RSFS, and Pumping Plant 1. The one longfin smelt (7.3 mm TL) was collected at the Headworks in March 2008 and the one delta smelt (8.3 mm TL) was collected at the RSFS in May 2012.

Table 15 Summary of information regarding larval fish sampling and the collection of listed species at Rock Slough Headworks, PP1, and RSFS

Year	Start Date	Total # of Samples	# of Delta Smelt Collected	# of Longfin Smelt Collected
2004	March 22	34	0	0
2005	March 29	26	0	0
2006	May 5	15	0	0
2007	March 15	23	0	0
2008	March 3	30	0	1 (March) 7.3 mm TL
2009[1]	May 19	13	0	0
2010	May 20	7	0	0
2011[2]	No sampling	N/A	N/A	N/A
2012	January 13	67	1 (May) 8.3 mm TL	0
2013	January 2	75	0	0
2014	January 8	50	0	0
2015	March 19[3]	45	0	0
Total		**385**	**1**	**1**

Notes:
1. Water diversions in the unlined Contra Costa Canal using portable bypass pumps began on May 18, 2009.
2. No larval fish sampling occurred in 2011 due to construction of the RSFS.
3. Use of Rock Slough as an intake ceased on May 7, 2014 to support construction of Segment 2 of the Canal Replacement Project; sampling resumed in March 2015 when diversions began.
Source: CCWD 2015.

CDFW Surveys

The results of three CDFW surveys were reviewed to determine if delta and longfin smelts have been collected at CCWD's trigger stations and at Station 804, which is located on the southern side of the San Joaquin River near Antioch. Data from the Station 804 are useful for comparison to trigger station data because Station 804 is located in a mainstem river environment, more closely connected to spawning grounds. The surveys examined were the Smelt Larva Survey (2009–2015), the 20-mm Survey (2007–2015), and the Summer Townet Survey (2007–2015). Figure 3-3 provides a map of the location of the CDFW stations.

CDFW Smelt Larva Survey The Smelt Larva Survey, initiated in January 2009, provides near real-time distribution data for longfin smelt larvae in the Delta, Suisun Bay, and Suisun Marsh. Sampling takes place within the first two weeks of January and repeats every other week through the second week in March. Each 4-day survey consists of a single 10-minute oblique tow conducted at 35 station locations using an egg and larva net. The 505-micron mesh net is hung on a rigid frame shaped like an inverted-U, which in turn is attached to skis to prevent it from digging into the bottom when deployed. The net mouth area measures 0.37 m^2. The conical net tapers back from the frame 3.35 m to a 1-liter cod-end jar, which collects and concentrates the sample. Immediately after each tow, juvenile fish are removed, identified, measured, and returned to the water, and the remaining larvae are preserved in 10% formalin and returned to the laboratory for identification. Table 16 provides the start and end dates of the Smelt Larva Surveys from 2009–2015.

Table 16 Start and end dates of the Smelt Larva Survey from 2009 through 2015

Year	Date of First Survey	Date of Last Survey
2009	January 5	March 3
2010	January 4	March 24
2011	January 18	March 23
2012	January 9	March 20
2013	January 2	March 19
2014	January 6	March 21
2015	January 5	March 26

In order to determine if larval life stages of longfin smelt and delta smelt[7] were collected near the vicinity of the Project, data were examined from Smelt Larva Survey stations located in the vicinity of the Rock Slough Project. The examined data were collected from CCWD's five "trigger" stations (901, 902, 914, 915, and 918) used to initiate annual CCWD's ichthyoplankton monitoring and at Station 804 located on the lower San Joaquin River.

The concentrations (#/1,000 m^3 water sampled) of delta smelt and longfin smelt collected during the Smelt Larva Survey from 2009 – 2015 at CCWD's trigger stations and at Station 804 are provided in Tables 17 and 18, respectively. No delta smelt were collected at any of the trigger stations or at Station 804 during 2009 – 2011. In 2012, larval delta smelt were collected during the last survey (March 19, 2012) at Station 901 (concentration = 18.59/1,000 m^3 water sampled), Station 914 (concentration = 4.96/1,000 m^3 water sampled), and Station 804 (concentration = 13.14/1,000 m^3 water sampled) (Table 17). In 2013, delta smelt were collected on March 18, 2013 at Station 902 (concentration = 15.58/1,000 m^3 water sampled). No delta smelt were collected in 2014. In 2015, delta smelt were collected on March 24, 2015 at Station 902 (concentration = 14.88/1,000 m^3 water sampled). Larval longfin smelt were collected at most trigger stations throughout the 2009 – 2015 surveys and were collected during every survey at Station 804 except during the January 2, 2013 survey and the March 17, 2014 survey (Table 18). With the exception of six surveys, concentrations of longfin smelt were always highest at Station 804 when compared to concentrations at the trigger stations. At the trigger stations, the highest concentrations each year occurred at Station 901 (Frank's Tract) (Table 18).

Table 17 Mean concentration of delta smelt (#/1,000 m^3) collected during CDFW's Smelt Larva Survey from 2009 through 2015 at CCWD's five "trigger stations" in the south Delta and at Station 804 on the lower San Joaquin River

	Mean Concentration (#/1,000 m^3) Station					
Survey Date	901	902	914	915	918	804
1/5/2009	0	0	0	0	0	0

[7] Listed salmonids and green sturgeon would not be collected during the Smelt Larval Survey.

	Mean Concentration (#/1,000 m^3) Station					
Survey Date	**901**	**902**	**914**	**915**	**918**	**804**
1/20/2009	0	0	0	0	0	0
2/2/2009	0	0	0	0	0	0
2/17/2009	0	0	0	0	0	0
3/2/2009	0	0	0	0	0	0
1/4/2010	0	0	0	0	0	0
1/19/2010	0	0	0	0	0	0
2/1/2010	0	0	0	0	0	0
2/16/2010	0	0	0	0	0	0
3/1/2010	0	0	0	0	0	0
3/23/2010	0	0	0	0	0	0
1/18/2011	0	0	0	0	0	0
1/31/2011	0	0	0	0	0	0
2/14/2011	0	0	0	0	0	0
2/28/2011	0	0	0	0	0	0
3/22/2011	0	0	0	0	0	0
1/9/2012	0	0	0	0	0	0
1/23/2012	0	0	0	0	0	0
2/6/2012	0	0	0	0	0	0
2/21/2012	0	0	0	0	0	0
3/5/2012	0	0	0	0	0	0
3/19/2012	18.59	0	4.96	0	0	13.14
1/2/2013	0	0	0	0	0	0
1/14/2013	0	0	0	0	0	0
1/28/2013	0	0	0	0	0	0
2/11/2013	0	0	0	0	0	0
2/25/2013	0	0	0	0	0	0
3/18/2013	0	15.58	0	0	0	0
1/6/2014	0	0	0	0	0	0
1/21/2014	0	0	0	0	0	0
2/3/2014	0	0	0	0	0	0
2/18/2014	0	0	0	0	0	0
3/3/2014	0	0	0	0	0	0
3/17/2014	0	0	0	0	0	0
1/5/2015	0	0	0	0	0	0
1/20/2015	0	0	0	0	0	0
2/2/2015	0	0	0	0	0	0
2/17/2015	0	0	0	0	0	0
3/2/2015	0	0	0	0	0	0
3/24/2015	0	14.88	0	0	0	0

Table 18 Mean concentration of longfin smelt (#/1,000 m^3) collected during CDFW's Smelt Larva Survey from 2009 through 2015 at CCWD's five "trigger stations" in the south Delta and at Station 804 on the lower San Joaquin River

	Mean Concentration (#/1,000 m^3) Station					
Survey Date	**901**	**902**	**914**	**915**	**918**	**804**
1/5/2009	5.11	0	0	0	0	17.54
1/20/2009	96.91	36.07	10.16	17.97	5.47	417.17
2/2/2009	38.11	35.88	14.21	69.24	10.91	178.41
2/17/2009	113.17	72.61	23.51	94.39	32.26	330.14
3/2/2009	41.98	0	4.72	0	10.17	218.31
1/4/2010	60.14	30.7	3.96	8.28	0	88.62
1/19/2010	297.79	64.29	9.21	45.3	16.28	473.42
2/1/2010	177.01	45.32	0	18.74	19.01	589.45
2/16/2010	47.16	14.02	0	15.17	5.18	235.91
3/1/2010	23.84	4.82	0	0	4.88	118.32
3/23/2010	28.11	5.05	0	11.82	0	266.90
1/18/2011	5.32	4.81	0	0	0	69.08
1/31/2011	171.65	5	0	5	5.03	343.17
2/14/2011	36.04	51.25	4.61	4.88	9.78	352.53
2/28/2011	16.7	5.41	0	0	0	5.18
3/22/2011	5.41	4.83	0	5.19	0	10.89
1/9/2012	4.82	46.77	0	4.69	19.48	185.33
1/23/2012	671.88	121.43	44.24	43.18	11.09	2050.81
2/6/2012	77.7	47.77	8.43	40	8.23	358.49
2/21/2012	133	28.76	17.15	26.26	30.83	294.86
3/5/2012	16.48	16.28	5.44	10.79	0	691.01
3/19/2012	30.98	12.16	0	0	0	52.54
1/2/2013	22.49	0	0	0	0	0
1/14/2013	34.52	0	0	0	0	71.76
1/28/2013	259.06	4.34	4.69	8.73	0	148.11
2/11/2013	201.15	64.43	9.79	43.03	32.4	218.57
2/25/2013	31.47	50.15	0	18.95	9.81	327.82
3/18/2013	18.48	5.19	0	14.41	0	243.47
1/6/2014	25.1	0	0	6.67	0	40.52
1/21/2014	79.27	35.55	0	5	10.33	111.1
2/3/2014	49.19	5.56	5.27	45.1	0	109.17
2/18/2014	10.75	21.5	0	0	0	16.49
3/3/2014	56.33	0	0	0	0	21.03
3/17/2014	0	0	0	0	0	0
1/5/2015	0	0	0	0	0	28.97
1/20/2015	0	0	0	0	0	4.48
2/2/2015	8.63	0	9.36	4.85	0	21.77
2/17/2015	4.92	0	0	4.49	0	18.59
3/2/2015	0	0	5.16	0	0	26.08
3/24/2015	21.37	0	0	0	0	101.42

CDFW 20-mm Survey The 20-mm Survey monitors postlarval-juvenile delta smelt distribution and relative abundance throughout their historical spring range in the Sacramento-San Joaquin Delta and San Francisco Estuary. This survey gets its name from the size (20-mm) at which delta smelt are retained and readily identifiable at the fish facilities associated with the CVP and SWP. The number of surveys conducted each year ranges from 8 – 10. Surveys are conducted every other week at stations throughout the Delta and downstream to the eastern portion of San Pablo Bay and the Napa River. Samples are collected using a rigid opening net constructed of 1,600-micron mesh. Three 10-minute stepped-oblique tows are made at each station.

Delta smelt were collected in low concentrations at CCWD's trigger stations and at Station 804 from 2007 – 2015 (Table 19). No delta smelt have been collected past early June at any CCWD trigger stations from 2007 – 2015; the latest they were collected was on June 9, 2008 at Station 901 (concentration = 4.02/10,000 m^3 water sampled) (Table 19). No delta smelt were collected at any CCWD trigger stations in 2014. Delta smelt were only collected during two surveys at CCWD trigger stations in 2015; concentrations were less than 3.5/10,000 m^3 water sampled. At Station 804 from 2007 – 2011, delta smelt were collected as late as the first week of July in 2010 (July 6, 2010; concentration = 3.62/10,000 m^3 water sampled).

Table 19 Mean concentration of delta smelt (#/10,000 m^3) collected during CDFW's 20-mm Survey from 2007 through 2015 at CCWD's five "trigger stations" in the south Delta and at Station 804 on the lower San Joaquin River

	Concentration #/10,000 m^3					
	Station					
Date	**901**	**902**	**914**	**915**	**918**	**804**
3/13/2007	0	0	0	0	0	3.45
3/26/2007	0	0	0	0	0	0
4/9/2007	0	0	0	0	0	0
4/23/2007	0	0	0	0	0	0
5/7/2007	7.49	0	0	0	0	3.47
5/21/2007	0	0	0	0	0	3.81
6/4/2007	0	0	0	0	0	0
6/18/2007	0	0	0	0	0	3.60
7/2/2007	0	0	0	0	0	0
3/3/2008	0	0	0	0	0	0
3/17/2008	0	0	0	0	0	0
4/1/2008	0	0	0	0	0	0
4/14/2008	0	0	0	0	0	0
4/28/2008	0	6.91	0	3.56	0	3.27
5/12/2008	4.14	3.55	3.31	0	0	3.72
5/27/2008	3.62	3.58	0	0	0	7.27
6/9/2008	4.02	0	0	0	0	10.40
6/23/2008	0	0	0	0	0	3.35
7/7/2008	0	0	0	0	0	0
3/9/2009	0	0	0	0	0	0
3/23/2009	0	0	0	0	0	0
4/6/2009	0	0	3.32	0	0	0
4/20/2009	0	0	3.57	0	0	0
5/4/2009	13.83	0	0	0	0	3.27
5/18/2009	0	0	0	0	0	3.17
6/1/2009	0	0	0	0	0	7.10
6/15/2009	0	0	0	0	0	3.35
6/29/2009	0	0	0	0	0	0
3/15/2010	0	0	0	0	0	0
3/29/2010	0	0	0	0	0	0
4/12/2010	0	0	0	0	0	0
4/26/2010	0	0	0	0	0	3.56

	Concentration #/10,000 m^3					
	Station					
Date	**901**	**902**	**914**	**915**	**918**	**804**
5/10/2010	0	0	0	0	0	0
5/24/2010	0	0	0	0	0	3.00
6/7/2010	0	0	0	0	0	0
6/21/2010	0	0	0	0	0	0
7/6/2010	0	0	0	0	0	3.62
3/14/2011	0	0	0	0	0	0
3/28/2011	0	0	0	0	0	0
4/11/2011	0	0	0	0	0	0
4/25/2011	0	0	0	0	0	0
5/9/2011	0	0	0	0	0	0
5/23/2011	7.38	0	0	0	0	0
6/6/2011	0	0	0	0	0	3.68
6/20/2011	0	0	0	0	0	0
7/5/2011	0	0	0	0	0	0
3/12/2012	0	0	0	0	0	0
3/26/2012	3.29	0	0	0	0	0
4/9/2012	0	3.59	13.85	0	0	0
4/23/2012	0	0	0	0	0	3.63
5/7/2012	0	0	0	7.28	0	26.16
5/21/2012	0	0	0	0	0	10.9
6/4/2012	0	0	3.85	3.69	0	17.87
6/18/2012	0	0	0	0	0	7.34
7/9/2012	0	0	0	0	0	0
3/11/2013	0	0	0	0	0	0
3/25/2013	6.5	0	3.94	3.95	7.66	15.04
4/8/2013	26.8	7.65	0	3.42	0	22.82
4/22/2013	0	0	0	0	0	27.67
5/6/2013	0	23.44	0	0	0	90.52
5/20/2013	0	0	0	0	0	15.82
6/3/2013	0	0	0	0	0	7.32
6/17/2013	0	0	0	0	0	0
7/1/2013	0	0	0	0	0	0
3/17/2014	0	0	0	0	0	0
4/2/2014	0	0	0	0	0	0
4/14/2014	0	0	0	0	0	7.59
4/28/2014	0	0	0	0	0	0
5/12/2014	0	0	0	0	0	3.75
5/27/2014	0	0	0	0	0	0
6/9/2014	0	0	0	0	0	0
6/23/2014	0	0	0	0	0	0
7/7/2014	0	0	0	0	0	0
3/16/2015	0	0	0	0	0	0
3/30/2015	0	0	0	0	NS	0
4/13/2015	0	0	0	0	0	0
4/27/2015	0	0	0	3.5	0	0
5/11/2015	0	0	3.39	0	0	0
5/26/2015	0	0	0	0	0	0
6/8/2015	0	0	0	0	0	0
6/22/2015	0	0	0	0	0	0
7/6/2015	0	0	0	0	0	0

	Concentration #/10,000 m³					
	Station					
Date	901	902	914	915	918	804
NS=station not sampled.						

Longfin smelt have been collected in low concentrations at CCWD's trigger stations from 2007 – 2015 (Table 20). At CCWD trigger stations, no longfin smelt have been collected past mid-May (May 12, 2008; Station 901; concentration = 4.14/10,000 m^3 water sampled). No longfin smelt were collected at CCWD trigger stations in 2011. Longfin smelt were collected more frequently at Station 804 than at CCWD trigger stations during the 2007 – 2015 surveys. At Station 804 from 2007 – 2015, no longfin smelt were collected past late May (Table 20).

Table 20 Mean concentration of longfin smelt (#/10,000 m^3) collected during CDFW's 20-mm Survey from 2007 through 2015 at CCWD's five "trigger stations" in the south Delta and at Station 804 on the lower San Joaquin River

	Concentration #/10,000 m³					
	Station					
Date	901	902	914	915	918	804
3/13/2007	0	0	0	0	0	3.40
3/26/2007	0	0	0	0	0	3.13
4/9/2007	0	0	0	0	0	12.61
4/23/2007	3.73	3.54	0	0	0	13.37
5/7/2007	0	0	0	0	0	0
5/21/2007	0	0	0	0	0	0
6/4/2007	0	0	0	0	0	0
6/18/2007	0	0	0	0	0	0
7/2/2007	0	0	0	0	0	0
3/3/2008	0	0	0	0	0	43.63
3/17/2008	0	0	0	0	0	208.39
4/1/2008	3.59	3.72	0	0	7.46	307.63
4/14/2008	40.06	14.34	3.45	0	3.88	658.78
4/28/2008	28.56	0	0	7.04	3.56	811.68
5/12/2008	4.14	0	0	0	0	203.00
5/27/2008	0	0	0	0	0	64.19
6/9/2008	0	0	0	0	0	0
6/23/2008	0	0	0	0	0	0
7/7/2008	0	0	0	0	0	0
3/9/2009	3.7	0	3.53	0	11.13	3.57
3/23/2009	3.01	0	0	0	0	43.83
4/6/2009	3.55	3.3	0	0	3.29	1364.52
4/20/2009	8.26	10.59	0	3.6	0	33.48
5/4/2009	0	0	0	0	0	3.24
5/18/2009	0	0	0	0	0	0
6/1/2009	0	0	0	0	0	0
6/15/2009	0	0	0	0	0	0
6/29/2009	0	0	0	0	0	0
3/15/2010	0	0	0	0	0	3.39
3/29/2010	3.69	3.68	0	0	0	21.59
4/12/2010	3.51	0	0	0	0	0
4/26/2010	0	0	0	0	0	7.11
5/10/2010	9	0	0	0	0	0

	Concentration #/10,000 m^3					
	Station					
Date	**901**	**902**	**914**	**915**	**918**	**804**
5/24/2010	0	0	0	0	0	0
6/7/2010	0	0	0	0	0	0
6/21/2010	0	0	0	0	0	0
7/6/2010	0	0	0	0	0	0
3/14/2011	0	0	0	0	0	10.76
3/28/2011	0	0	0	0	0	0
4/11/2011	0	0	0	0	0	0
4/25/2011	0	0	0	0	0	0
5/9/2011	0	0	0	0	0	0
5/23/2011	0	0	0	0	0	0
6/6/2011	0	0	0	0	0	0
6/20/2011	0	0	0	0	0	0
7/5/2011	0	0	0	0	0	0
3/12/2012	10.75	0	18.97	11.09	0	30.99
3/26/2012	3.64	3.59	0	7.06	3.71	7.07
4/9/2012	0	0	0	7.51	0	18.97
4/23/2012	0	3.77	0	0	0	0
5/7/2012	0	0	0	0	0	0
5/21/2012	0	0	0	0	0	0
6/4/2012	0	0	0	0	0	0
6/18/2012	0	0	0	0	0	0
7/9/2012	0	0	0	0	0	0
3/11/2013	0	0	0	7.49	0	105.73
3/25/2013	31.52	7.9	0	31.78	3.92	310.94
4/8/2013	119.53	19.34	0	0	3.62	87.63
4/22/2013	0	3.94	0	0	0	399.59
5/6/2013	0	0	0	0	0	871.4
5/20/2013	0	0	0		0	250.86
6/3/2013	0	0	0	0	0	0
6/17/2013	0	0	0	0	0	0
7/1/2013	0	0	0	0	0	0
3/17/2014	41.48	7.9	0	0	0	19.3
4/2/2014	0	0	3.76	0	0	25.63
4/14/2014	3.59	0	0	0	0	0
4/28/2014	4.06	0	0	0	0	7.88
5/12/2014	0	0	0	0	0	0
5/27/2014	0	0	0	0	0	0
6/9/2014	0	0	0	0	0	0
6/23/2014	0	0	0	0	0	0
7/7/2014	0	0	0	0	0	0
3/16/2015	0	0	0	0	3.49	9.25
3/30/2015	6.21	12.92	0	0	NS	9.84
4/13/2015	0	3.68	0	0	0	3.42
4/27/2015	7.66	0	0	0	3.5	6.87
5/11/2015	0	0	0	0	0	0
5/26/2015	0	0	0	0	0	0
6/8/2015	0	0	0	0	0	0

	Concentration #/10,000 m^3					
	Station					
Date	901	902	914	915	918	804
6/22/2015	0	0	0	0	0	0
7/6/2015	0	0	0	0		0
NS=station not sampled.						

CDFW Summer Townet Survey Since 1959, the Summer Townet Survey has developed indices for the abundance of young striped bass when the average size is 38 mm by sampling 32 historic stations from eastern San Pablo Bay to Rio Vista on the Sacramento River and to Stockton on the San Joaquin River. Data from 31 of the historic stations are used to calculate indices for several species. In 2011, eight "supplemental" stations (three in Cache Slough and five in the Sacramento Deep Water Ship Channel) were added to the Summer Townet Survey. Data from these eight stations do not contribute to the calculation of the indices. Historically, the Summer Townet Survey began in mid-to late-June when sampling near Antioch demonstrated that young-of-the-year striped bass had achieved a mean size of 25 mm. In 2003, CDFW began sampling six surveys a year, starting in early June and running on alternate weeks through August. Two 10-minute stepped oblique tows are conducted at each station. At the historic stations, a third tow is conducted if any fish are captured during the first two tows.

The tow net has two sections. The first section is six feet long is made of ½-in. stretch, knotted, nylon mesh that tapers down to an additional two-foot "fyke". The fyke fits entirely within the second section, a nine-foot section of woven mesh with approximately eight holes per inch. The entire net measures approximately 15 feet. The net is lashed directly to a fixed metal "D" frame that is mounted on a 22-pound sled.

No delta smelt were collected in CDFW's Summer Townet Survey at CCWD's trigger stations from 2007 – 2015 (Table 21). At Station 804 from 2007 – 2015, delta smelt were only collected on June 8, 2009 (concentration = 3.94/10,000 m^3 water sampled), June 22, 2009 (concentration = 3.68/10,000 m^3 water sampled), June 25, 2012 (concentration = 3.47/10,000 m^3 water sampled), and August 19, 2013 (concentration = 3.59/10,000 m^3 water sampled) (Table 21).

Table 21 Mean concentration of delta smelt (#/10,000 m^3) collected during CDFW's Summer Townet Survey from 2007 through 2015 at CCWD's "trigger stations" in the south Delta and Station 804 on the lower San Joaquin River

	Concentration (#/10,000 m^3)				
	Station				
Date	902	914	915	918	804
6/11/2007	0	0	0	0	0
6/25/2007	0	0	0	NS	0
7/9/2007	0	0	0	0	0
7/23/2007	0	0	0	0	0
8/6/2007	0	0	0	0	NS
8/20/2007	0	0	0	0	0
6/2/2008	NS	0	NS	0	NS*
6/16/2008	NS	NS	NS	NS	NS
6/30/2008	0	0	NS	0	NS
7/14/2008	0	0	0	0	NS

	Concentration (#/10,000 m^3)				
	Station				
Date	**902**	**914**	**915**	**918**	**804**
7/28/2008	0	0	0	0	0
8/11/2008	0	0	0	0	0
6/8/2009	0	0	0	NS	3.94
6/22/2009	0	0	0	NS	3.68**
7/6/2009	0	0	0	0	0
7/20/2009	0	0	0	0	0
8/3/2009	0	0	0	0	NS
8/17/2009	0	0	0	0	0
6/14/2010	0	0	0	0	0
6/28/2010	0	0	0	0	0
7/14/2010	0	0	0	0	N/S
7/27/2010	0	0	0	0	0
8/10/2010	0	0	0	0	0
8/23/2010	0	0	0	0	0
6/13/2011	NS	0	0	0	0
6/27/2011	NS	0	0	0	0
7/11/2011	0	0	0	0	0
7/25/2011	0	0	0	0	0
8/8/2011	0	0	0	0	0
8/22/2011	0	0	0	0	0
6/11/2012	0	0	0	0	0
6/25/2012	0	0	0	0	3.47
7/9/2012	0	0	0	0	0
7/23/2012	0	0	0	0	0
8/6/2012	0	0	0	0	0
8/20/2012	0	0	0	0	0
6/10/2013	0	0	0	0	0
6/24/2013	0	0	0	0	0
7/8/2013	0	0	0	0	0
7/22/2013	0	0	0	0	0
8/5/2013	0	0	0	0	0
8/19/2013	0	0	0	0	3.59
6/2/2014	0	0	0	0	0
6/16/2014	0	0	0	0	0
6/30/2014	0	0	0	0	0
7/14/2014	0	0	0	0	0
7/28/2014	0	0	0	0	0
8/11/2014	0	0	0	0	0
6/1/15	0	0	0	0	0
6/16/15	0	0	0	0	0
6/29/15	0	0	0	0	0
7/13/15	0	0	0	0	0
7/27/15	0	0	0	0	0
8/10/15	0	0	0	0	0

Notes:
CCWD trigger station 901 is not sampled during the Summer Townet Survey.
NS means that the station was not sampled.

	Concentration (#/10,000 m^3)				
	Station				
Date	902	914	915	918	804
*Although delta smelt data showed the station was not sampled, there were data for longfin smelt (see Table 22). ** Although there were data for delta smelt, longfin data showed that the station was not sampled (see Table 22).					

No longfin smelt were collected in CDFW's Summer Townet Survey at CCWD's trigger stations from 2007 – 2015 (Table 22). At Station 804 from 2007 – 2015, longfin smelt were only collected on June 2, 2008 (concentration = 69.51/10,000 m^3 water sampled), June 8, 2009 (concentration = 3.94/10,000 m^3 water sampled), June 10, 2013 (concentration = 20.91/10,000 m^3 water sampled), and June 24, 2013 (concentration = 7.26/10,000 m^3 water sampled) (Table 22).

Table 22 Mean concentration of longfin smelt (#/10,000 m^3) collected during CDFW's Summer Townet Survey from 2007 through 2015 at CCWD's five "trigger stations" in the South Delta and Station 804 on the lower San Joaquin River

	Concentration (#/10,000 m^3)				
	Station				
Date	902	914	915	918	804
6/11/2007	0	0	0	0	0
6/25/2007	0	0	0	NS	0
7/9/2007	0	0	0	0	0
7/23/2007	0	0	0	0	0
8/6/2007	0	0	0	0	N/S
8/20/2007	0	0	0	0	0
6/2/2008	NS	0	NS	0	69.51*
6/16/2008	NS	N/S	NS	NS	NS
6/30/2008	0	0	NS	0	NS
7/14/2008	0	0	0	0	NS
7/28/2008	0	0	0	0	0
8/11/2008	0	0	0	0	0
6/8/2009	0	0	0	NS	3.94
6/22/2009	0	0	0	NS	NS**
7/6/2009	0	0	0	0	0
7/20/2009	0	0	0	0	0
8/3/2009	0	0	0	0	NS
8/17/2009	0	0	0	0	0
6/14/2010	0	0	0	0	0
6/28/2010	0	0	0	0	0
7/14/2010	0	0	0	0	NS
7/27/2010	0	0	0	0	0
8/10/2010	0	0	0	0	0
8/23/2010	0	0	0	0	0
6/13/2011	NS	0	0	0	0
6/27/2011	NS	0	0	0	0
7/11/2011	0	0	0	0	0
7/25/2011	0	0	0	0	0
8/8/2011	0	0	0	0	0
8/22/2011	0	0	0	0	0
6/11/2012	0	0	0	0	0
6/25/2012	0	0	0	0	0

	Concentration (#/10,000 m^3)				
	Station				
Date	**902**	**914**	**915**	**918**	**804**
7/9/2012	0	0	0	0	0
7/23/2012	0	0	0	0	0
8/6/2012	0	0	0	0	0
8/20/2012	0	0	0	0	0
6/10/2013	0	0	0	0	20.91
6/24/2013	0	0	0	0	7.26
7/8/2013	0	0	0	0	0
7/22/2013	0	0	0	0	0
8/5/2013	0	0	0	0	0
8/19/2013	0	0	0	0	0
6/2/2014	0	0	0	0	0
6/16/2014	0	0	0	0	0
6/30/2014	0	0	0	0	0
7/14/2014	0	0	0	0	0
7/28/2014	0	0	0	0	0
8/11/2014	0	0	0	0	0
6/1/15	0	0	0	0	0
6/16/15	0	0	0	0	0
6/29/15	0	0	0	0	0
7/13/15	0	0	0	0	0
7/27/15	0	0	0	0	0
8/10/15	0	0	0	0	0

Notes:
CCWD trigger station 901 is not sampled during the Summer Townet Survey.
NS means that the station was not sampled.
**Although delta smelt data showed the station was not sampled (see Table 21), there were data for longfin smelt.
** Although there were data for delta smelt (see Table 21), longfin data showed that the station was not sampled.

Summary

The results of CCWD's Rock Slough and PP1 fish monitoring (larval fish and sieve nets) and results of CDFW's Smelt Larva Survey, 20-mm Survey, and Summer Townet Survey at CCWD's trigger stations and at Station 804 document very infrequent collection of all life stages of delta smelt and juvenile and adult longfin smelt. Larval longfin smelt were collected at CCWD trigger stations and Station 804 throughout the Smelt Larva Survey period. CCWD's monitoring data shows that from 2004 through 2015, only one larval delta smelt was collected at the RSFS (May 2012; 8.3 mm TL) and only one larval longfin smelt was collected (Headworks; March 2008; 7.3 mm TL) (Table 15). CDFW Smelt Larva Survey results from 2009 – 2015 show that delta smelt have only been collected at CCWD's trigger stations and at Station 804 during three surveys (one in 2012, one in 2013, and one in 2015) (Table 17) although longfin smelt are collected throughout the Smelt Larva Survey period (Table 18). Nearly 900 CCWD sieve net surveys have been conducted at the Headworks, PP1, and RSFS from 2004–November 2015. No longfin smelt have been collected and only one delta smelt was collected (February 2005; 66 mm FL) during this time (Table 13). CDFW's 20-mm Survey uses the same mesh size to collect as the CCWD sieve net; their 2007 – 2015 data show that the latest collection of delta smelt at CCWD's trigger stations occurred in early June (2008) and the latest collection of delta smelt at Station 804 occurred in mid-June (2010) (Table 19). No longfin were ever collected past late-May (Station 804 in 2008) during the 20-mm Survey (Table 20) from 2007 – 2015. No delta smelt or longfin smelt were collected during CDFW's Summer Townet Survey at CCWD's trigger stations from 2007 – 2015 (Tables 21 and 22) and both species were infrequently collected in June at Station 804.

3.2 Federally Listed Species Addressed in this Biological Assessment

As described in Section 3.1, seven listed species have been reported in the vicinity of the Project. These include four fish species under the jurisdiction of NMFS (Sacramento River winter-run Chinook salmon ESU, Central Valley spring-run Chinook salmon ESU, Central Valley steelhead DPS, and southern DPS of North American green sturgeon); and two species under the jurisdiction of the USFWS (delta smelt and giant garter snake). In addition, the longfin smelt San Francisco Bay-Delta population was proposed for listing under ESA on May 6, 2008 and occurs in the Project vicinity. Longfin smelt is a candidate for federal listing as an endangered or threatened species (USFWS 2015) and is a California state-listed threatened species. This section describes population trends, life history, and factors affecting abundance for these species. This section also discusses the species' critical habitat and recovery plans, where applicable.

3.2.1 Sacramento River Winter-run Chinook Salmon ESU

Sacramento River winter-run Chinook salmon ESU was formally listed as threatened under ESA in November 1990 (55 FR 46515), and reclassified as endangered under ESA in January 1994 (59 FR 440). In 2004, NMFS evaluated whether Sacramento River winter-run Chinook salmon was still in danger of extinction and proposed downgrading their status to threatened; however, after review, NMFS determined in 2005 that the protective measures in place were not enough to alter the level of extinction risk and therefore the status should remain endangered (70 FR 37160). The Sacramento River winter-run Chinook salmon ESU consists of only one population that uses spawning habitat restricted to the upper reaches of the Sacramento River below Keswick Dam, in California's Central Valley.

Critical Habitat

Critical habitat was designated by NMFS for Sacramento River winter-run Chinook salmon in June 1993 (58 FR 33212). The critical habitat area was delineated as the Sacramento River from Keswick Dam to Chipps Island at the westward margin of the Sacramento-San Joaquin Delta, including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge. In the areas west of Chipps Island, including San Francisco Bay to the Golden Gate Bridge, this designation includes the estuarine water column and essential foraging habitat and food resources utilized by Sacramento River winter-run Chinook salmon as part of their juvenile out-migration or adult spawning migrations. Waters adjacent to the Project Area (Sand Mound Slough, Rock Slough, and Dutch Slough) are not within the designated critical habitat for Sacramento River winter-run Chinook salmon (B. Oppenheim, NMFS, pers. com. July 20, 2015).

Primary constituent elements (PCEs) for Sacramento River winter-run Chinook salmon critical habitat include:

- Migratory Access—passage from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River;
- Spawning Substrate—the availability of clean gravel for spawning substrate;
- Adequate River Flows—for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles;
- Water Temperatures—between 42.5°F and 57.5°F for successful spawning, egg incubation, and fry development;
- Habitat Areas and Adequate Prey—that are not contaminated;
- Riparian Habitat—that provides for successful juvenile development and survival; and
- Access Downstream—so that juveniles can migrate from the spawning grounds to San Francisco Bay and the Pacific Ocean.

Trends

The Sacramento River winter-run Chinook salmon is endemic to the Sacramento-San Joaquin Estuary. Sacramento River winter-run Chinook salmon historically used the upper reaches of the McCloud, Pit, and Little Sacramento rivers above Keswick and Shasta dams, and in Battle Creek. Based on commercial fishery landings in the 1870s, Fisher (1992) estimated that the total run size of Sacramento River winter-run Chinook salmon may have been 200,000 fish. In the 1940s access to these upper river reaches was blocked by the completion of the Shasta and Keswick dams. The Sacramento River winter-run Chinook salmon continued to use the mainstem, taking advantage of the cool water below the newly constructed dams. Runs averaged 80,000 adults in the late 1960s, reaching a high of 117,808 spawners in 1969. In 1970, Sacramento River winter-run Chinook salmon numbers dropped sharply and by 1987 through 1989 only 2,000 were counted. A few Sacramento River winter-run Chinook salmon were observed in the Calaveras River during the 1980s (CDFG 1993). Sacramento River winter-run escapement fell below 200 fish in the 1990s (Good et al. 2005). Data indicate a generally increasing population during the 2000s, however Sacramento River winter-run Chinook salmon populations declined in 2007 (Reclamation 2008). Lindley et al. (2007, as cited in Moyle et al.

2008) determined that populations were trending upwards with an estimated growth rate of 28% per year and an average of 8,140 spawners in a given year. According to Moyle et al. (2008), winter-run Chinook are considered the most ‘at risk’ salmonid due to a unique life history which includes spawning and incubation occurring during the most thermally challenging time of year, making them susceptible to climate change and drought. The blocking of access to spawning areas by the Shasta and Keswick dams in the 1940s is the greatest single cause of winter-run Chinook decline. The decline in the 1980s and early 1990s was triggered by a combination of excessively warm water releases from the Shasta Dam, barriers to fish passage, entrainment in water diversions, and possible heavy metal contamination and acid mine drainage from Iron Mountain Mine (NMFS 1997 as cited in Moyle et al. 2008). Furthermore, catastrophic events such as prolonged drought, forest fire, volcanic activity, and toxic spills have had extremely adverse impacts on the population. All adverse impacts to winter-run Chinook are compounded by the lack of geographical redundancy of the species. Winter-run Chinook salmon have declined from having 200,000 fish divided among four populations to having just a few thousand in one population. In 2007 fewer than 2,500 winter-run Chinook salmon returned to spawn (Moyle et al. 2008). The Sacramento River winter-run Chinook salmon population is currently limited to the mainstem of the Sacramento River below Keswick Dam.

Life History

The runs of Chinook salmon in California are distinguished by several physical and temporal properties, including the maturity of fish entering freshwater, time of spawning migrations, spawning areas, incubation times, incubation temperature requirements, and migration timing of juveniles.

The migration and spawning time of the Sacramento River winter-run Chinook salmon is unique among the Chinook salmon populations. Adult Sacramento River winter-run Chinook salmon return to freshwater during the winter but delay spawning until the spring and summer (Moyle 2002). Specifically, adult Sacramento River winter-run Chinook salmon enter into San Francisco Bay from November through June (Van Woert 1958, Hallock et al. 1957 as cited in NMFS 1997), migrate through the Sacramento-San Joaquin Estuary, and pass the Red Bluff Diversion Dam (RBDD) from December through early August (Hallock and Fisher 1985 as cited in NMFS 1997). Sacramento River winter-run Chinook salmon typically spend a long time holding in the river before spawning. The adults spawn in the mainstem of the Sacramento River from mid-April through August, with peak spawning occurring from May to June (NMFS 1997). In general, Sacramento River winter-run Chinook spawn in the area from Redding downstream to Tehama (Reclamation 2008). However, the spawning distribution is somewhat dependent on the operation of the gates at the RBDD, river flow, and temperature. Most Sacramento River winter-run Chinook migrate into the Sacramento River at three years of age.

Spawning takes place in swift, moderately shallow riffles or in areas along banks with fast moving water and abundant gravelly substrate. Depending on the population density, pre-spawning of Chinook salmon requires a territory of 18.6 to 60.4 m^2 (200 to 650 ft^2) (Resources Agency et al. 1998). The female digs a depression (redd) in the gravel and deposits several packets of eggs and buries them after they have been fertilized by the male. Spawning locations have a particular balance of water velocity and depth. Water velocity is more critical to the viability of the habitat than water depth. Incubating embryos buried in the gravel require sufficient water flow through the gravel for an oxygen supply and removal of metabolic wastes.

Water velocity in Chinook salmon spawning areas ranges from 0.3–1.1 meters per second (mps) (1.0–3.5 feet per second [fps]) and the optimum velocity is 0.46 mps (1.5 fps) (Resources Agency et al. 1998). Spawning depths fall between 0.3–1.5 m (1–5 ft) with a maximum depth 6.1 m (20 ft). A depth of less than 15.2 cm (6 in.) can be restrictive to Chinook salmon movement.

Water temperature is critical for migration and spawning of Chinook salmon. Sacramento River winter-run Chinook salmon prefer well-oxygenated water within a range of 13.9 to 19.4ºC (57 to 67ºF) for upstream migration and between 5.6 to 13.3ºC (42 and 56ºF) for spawning (Resources Agency et al. 1998). Temperatures outside of these thresholds decrease reproductive success.

Embryo incubation and fry emergence occurs from mid-April through mid-October. The fry can emigrate right after emergence, but most hold in the upper Sacramento River for many months. River rearing of Sacramento River winter-run Chinook salmon juveniles begins at the end of July and continues through May of the following year (Hallock and Fisher 1985 as cited in NMFS 1997). Emigration of fry and smolts occurs from July through March at the RBDD.

Juvenile Sacramento River winter-run Chinook salmon occur in the Delta primarily from November through early May, based on data collected from trawls in the Sacramento River at West Sacramento (USFWS 2001a and 2001b). Storm events and the resulting high flows appear to trigger movement of juveniles to downstream habitats. In order to limit predation, peak movement of juveniles tends to occur at night (Moyle et al. 2008). In the Delta, water temperatures probably do not affect juvenile winter-run Chinook salmon substantially until the spring when water temperatures increase (between April and June) (NMFS 1997). Sacramento River winter-run Chinook salmon juveniles remain in the Delta until they reach a FL of approximately 118 mm (4.6 in.) and are from five to 10 months of age, and then begin emigrating to the ocean as early as November and continue through May (Fisher 1994, Myers et al. 1998).

In the Delta, near the Project, juvenile Sacramento River winter-run Chinook salmon can be present from November through early May, while migrating adults can occur from November through June (NMFS 1997).

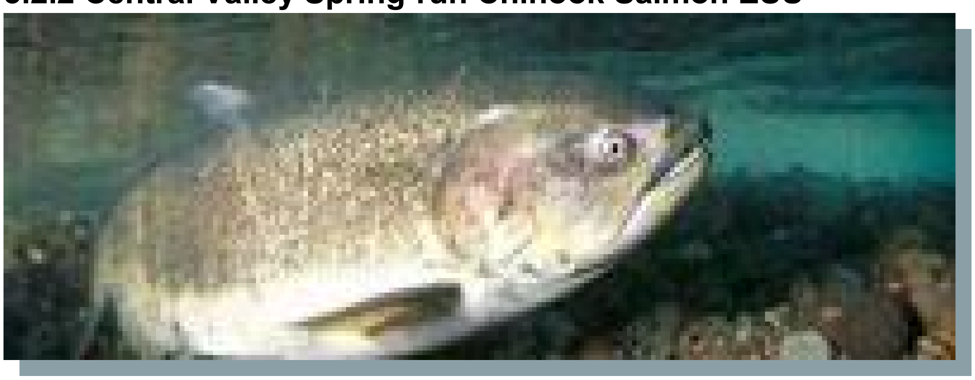
Factors Affecting Sacramento River Winter-run Chinook Salmon ESU

Several factors have contributed to the decline of the Sacramento River winter-run Chinook salmon, including degradation of spawning, rearing, and migration habitats. The primary factors include blockage of historical habitat by Shasta and Keswick dams, water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Delta, heavy metal contamination from Iron Mountain Mine, high ocean harvest rates, and entrainment in a large number of unscreened or poorly screened diversions (NMFS 1997). Dams have altered water temperatures and reduced habitat complexity, which reduce the productivity, abundance, and genetic integrity of Sacramento River winter-run Chinook salmon. The construction of the Shasta Dam blocked access to the entire historic spawning ground of Sacramento River winter-run Chinook salmon (Good et al. 2005). It is probable that there were several independent populations in the Pit, McCloud, and Little Sacramento rivers that merged into a single population after construction of the dam, resulting in reduced genetic diversity of the Sacramento winter-run Chinook salmon. In addition to Shasta Dam, the RBDD was considered one of the main reasons for Sacramento River winter-run Chinook salmon decline. Although the gates of the dam are now required to remain raised during Sacramento River winter-run Chinook salmon passage, an estimated 15% of fish still cannot pass the dam and must spawn downstream (Resources Agency et al. 1998). Periodic *El Nino* events in the Pacific Ocean may create unfavorable oceanic conditions, affecting salmon survival by altering upwelling and decreasing productivity, which in turn reduces food availability at sea. Commercial and recreational fisheries also may affect winter-run Chinook salmon as the fisheries do not discriminate between wild fish of any run (Moyle et al. 2008). Other threats include predation at artificial structures by nonnative species, pollution, adverse flow conditions, high summer water temperatures at spawning grounds, unsustainable harvest rates, passage problems at various structures, and vulnerability to drought (Good et al. 2005).

Recovery

A final recovery plan for the endangered Sacramento River winter-run Chinook salmon ESU was issued by NMFS in July 2014. No priority 1 or priority 2 recovery actions were developed for Sacramento River winter-run Chinook salmon in the mainstem San Joaquin River, near the area of the proposed Project (NMFS 2014).

3.2.2 Central Valley Spring-run Chinook Salmon ESU



The Central Valley spring-run Chinook salmon ESU was listed as threatened under ESA (64 FR 72960) and its threatened status was reaffirmed on June 28, 2005. This ESU includes all naturally spawned populations of Central Valley spring-run Chinook salmon in the Sacramento River and its tributaries, including the Feather River, in California (NOAA 1999). In July 2000, NMFS issued an ESA Section 4(d) rule for the Central Valley spring-run Chinook salmon ESU (65 FR 42422).

Critical Habitat

Critical habitat for Central Valley spring-run Chinook salmon was designated on September 2, 2005 (70 FR 52488) and became effective on January 2, 2006 (NOAA 2005). Central Valley spring run Chinook critical habitat designations include 1,158 miles of streams (1,863 km) and 254 mi^2 (655 m^2) of estuarine habitat (primarily in San Francisco, San Pablo, and Suisun Bays) in California. Counties with critical habitat designation include Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solano, Colusa, Yuba, Sutter, Trinity, Alameda, San Joaquin, and Contra Costa. Waters adjacent to the Project Area (Sand Mound Slough, Rock Slough, and Dutch Slough) are not within the designated critical habitat for Central Valley spring-run Chinook salmon (B. Oppenheim, NMFS, pers. com. July 20, 2015).

PCEs for Central Valley spring-run Chinook salmon critical habitat include:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring;
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without these features, juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (e.g., predator avoidance, competition) that help ensure their survival;
- Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores;
- Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fish, supporting growth and maturation. These features are essential to conservation because without them juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean. Similarly, these features are essential to the conservation of adults because they provide a final source of abundant forage that will provide the energy stores needed to make the physiological transition to fresh water, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas;
- Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fish, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. As in the case with freshwater migration corridors and estuarine areas, nearshore marine features are essential to conservation because without them juveniles cannot successfully transition from natal streams to offshore marine areas;
- Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fish, supporting growth and maturation. These features are essential for

conservation because without them juveniles cannot forage and grow to adulthood. However, it is difficult to identify specific areas containing this PCE as well as human activities that may affect the PCE condition in those areas. Therefore, specific areas have not been designated based on this PCE, but instead have been identified because they are essential to the species' conservation and specific offshore areas may be identified in the future (in which case any designation would be subject to separate rulemaking) (NOAA 2005).

Trends

Historically, Central Valley spring-run Chinook salmon were one of the largest runs on the Pacific Coast. Commercial gillnet fishery landings of spring-run Chinook in the Central Valley exceeded 600,000 fish in 1883 (CFGC 1885). In 1955, CDFW estimated that with proper water management the San Joaquin drainage could produce about 210,000 wild Chinook salmon per year (CDFG 1955). The last large run in the San Joaquin River occurred in 1945, when 56,000 fish migrated up the river (Fry 1961 as cited in NMFS 2009b). The San Joaquin River spring-run Chinook has since been extirpated, primarily due to the dewatering of the lower San Joaquin River following construction of Friant Dam in 1948, but also from blockage by the dam to upstream areas (Warner 1991).

After the demise of the San Joaquin stocks, Sacramento River spring-run Chinook salmon constituted the most abundant natural runs in the Central Valley. Historic run sizes for tributaries to the Sacramento River were estimated to be 15,000 above Shasta Dam (McCloud River, Pit River, Little Sacramento River); 8,000 to 20,000 in the Feather River above Oroville Dam; 6,000 to 10,000 in the Yuba River above Englebright Dam; and more than 10,000 in the American River above Folsom Dam (CDFG 1990). The Sacramento River drainage as a whole is estimated to have supported spring-run Chinook runs exceeding 100,000 fish in many years between the late 1800s and 1940s (Campbell and Moyle 1990).

The decline of Central Valley spring-run Chinook in the Sacramento drainage began when spawning streams were disrupted by gold mining and irrigation diversions, and accelerated following construction of Shasta Dam in 1945. CDFW estimates of spawning escapement in the mainstem Sacramento River range from 3,600 to 25,000 fish between 1969 and 1980, with an average population of 17,000 fish per year (Marcotte 1984). Overall, since 1940, more than 20 historically large populations of spring-run Chinook have been extirpated or reduced to nearly zero (Campbell and Moyle 1990). Four additional runs (Butte, Big Chico, Deer, and Mill creeks) have exhibited statistically significant declines. The only substantial, essentially wild populations of Central Valley spring-run Chinook salmon remaining in California are in Deer and Mill creeks in the Sacramento drainage and in the Salmon River in the Klamath-Trinity drainage (Campbell and Moyle 1990). Other populations tend to be supported by hatchery stocks.

Life History

The runs of Chinook salmon in California are distinguished by several physical and temporal properties, including the maturity of fish entering freshwater, time of spawning migrations, spawning areas, incubation times, incubation temperature requirements, and migration timing of juveniles.

Adult Central Valley spring-run Chinook salmon migrate from a marine environment into the freshwater streams and rivers of their birth to spawn. Adult Central Valley spring-run Chinook salmon leave the ocean to begin their upstream migration in late-January and early-February (CDFG 1998), and enter the Sacramento River between March and September, primarily in May and June (Yoshiyama et al. 1998, Moyle 2002). Most of the spawning population of Central Valley spring-run Chinook salmon are three-years-old, but can range from two to five years of age, and are sexually immature when they enter freshwater. While migrating and holding in the river, salmon do not feed, relying instead on stored body fat reserves for maintenance and gonadal maturation (Andersson 2003). The runs also may be bimodal, with some fish holding downstream to migrate later in the summer, possibly because of increasing water temperatures later in the spring (Marcotte 1984). Using mainly olfactory cues (Allen and Hassler 1986), the fish are fairly faithful to the natal streams in which they were spawned. Migratory adults require sufficient stream-flow to provide needed olfactory cues and also to allow their passage to holding and spawning habitat.

Central Valley spring-run Chinook adults occupy holding areas in response to the volume and depth of pools, amount of cover (especially bubble curtains created by inflowing water), and the proximity to patches of gravel suitable for spawning (G. Sato, BLM, unpublished data). Central Valley spring-run Chinook may hold in deep pools in upstream reaches for several months before spawning in early fall. Holding pools need to be cool, well oxygenated, and sufficiently deep to allow over-summer survival. Pools in which the adults hold are at least 1 to 3 m (1.1 to 9.8 ft) deep, with bedrock bottoms and moderate velocities (G. Sato, BLM, unpublished data, Marcotte 1984). Habitat preference curves determined by the USFWS for adult Chinook in the Trinity River indicate that pool use declines when depths become less than 2.4 m (7.8 ft) (Marcotte 1984).

Pre-spawning activity has been observed by mid-August and intensive redd-building activity and spawning occurs from the last week of August through the end of October (Parker and Hanson 1944, F. Fisher, as cited in USFWS 1996). Spawning first occurs in the upper reaches of streams and subsequently in lower reaches as water temperatures decrease (Parker and Hanson 1944). Spawning salmon are usually well distributed within a stream section, reducing competition for redd sites (Cramer and Hammack 1952). Water temperatures between 5.6 and 14.4°C (42 and 58°F) are most suitable for spawning. Mean water temperatures in pools where adult Chinook held during the summer of 1986 in Deer and Mill creeks were 16°C (60.8°F) (range 11.7 to 18°C [53.1 to 64.4°F]) and 20°C (68°F) (range 18.3 to 21.1°C [65 to 70°F]), respectively, and for juveniles in Mill Creek the temperature ranged from 13.3 to 22.2°C (56 to 72°F) (Sato and Moyle 1988). Sustained water temperatures above 27°C (80.6°F) are lethal to adults (Cramer and Hammack 1952).

Spawning occurs in gravel beds that are often located at tails of holding pools. Eggs are deposited in large depressions (redds) hollowed out in gravel beds. Optimum substrate for embryos is a mixture of gravel and rubble with less than 25% fines (less than 6.4 mm [2.5 in.] diameter) (Platts et al. 1979, Reiser and Bjornn 1979). The embryos hatch following a three to five month incubation period and the alevins (sac-fry) remain in the gravel for another two to three weeks. Newly emerged fry congregate in shallow, low-velocity edgewater, especially in areas where organic debris provides a background that makes the juveniles difficult to see (Moyle, unpublished data). Optimal temperatures for development are 5 to 13°C (41 to 55.4°F).

In Deer and Mill creeks, juvenile Central Valley spring-run Chinook spend nine to 10 months in the streams during most years, although some may spend as long as 18 months in freshwater (USFWS 1996). Juveniles in Deer Creek were found to prefer runs or riffles with gravel substrates, depths of 20 to 120 cm (7.9 to 47.2 in.), and mean water-column velocities of 20 to 40 cm (7.9 to 15.7 in.) per second (Sato and Moyle 1988). By the end of summer, the juveniles are 8 to 10 cm (3.1 to 3.9 in.) standard length (SL) (Moyle, unpublished observation).

Most juveniles move downstream in the first high flows of winter in November to early May with up to 69% of the young-of-the-year fish outmigrating through the lower Sacramento River and Delta during this period (CDFG 1998). In the Sacramento River, most downstream movement occurs in December through February (Vogel and Marine 1991). Timing of smolt emigration is variable because smolts may emigrate as young-of-the-year or as yearlings; therefore, most spring-run emigration occurs either during November and December or during March through May (Reclamation 2008). Out-migrants may spend some time in the Sacramento River or estuary to gain additional size before smolting and going out to sea, but most have presumably left the stream system by mid-May. Once in the ocean, salmon are largely piscivorous and grow rapidly, reaching 80 to 100 cm (31.5 to 39.4 in.) SL in two to three years. In general, adult spring-run Chinook salmon migrate upstream to spawn from March–September with peak migration in May–June (Moyle 2002). Most juveniles move downstream in the first high flows of winter in November through January, although some may persist through March (USFWS 1996). In the Sacramento River, most downstream movement occurs in December–February (Vogel and Marine 1991). Out-migrants may spend some time in the Sacramento River or Estuary to gain additional size before smolting and going out to sea, but most have presumably left the stream system by mid-May.

Factors Affecting Central Valley Spring-run Chinook Salmon ESU

The three major threats to Central Valley spring-run Chinook salmon include loss of historical spawning habitat, degradation of remaining habitat, and genetic threats from Feather River Hatchery practices (Good et al. 2005).

Suitable summer water temperatures for Central Valley spring-run Chinook salmon are found at elevations over 150 to 500 m (492 to 1,640 ft), however the construction of dams and water diversions along migratory streams has blocked the passage to many natal tributaries and has resulted in a reduction in the number of natural spawning populations (CDFG 1995). The construction of dams has resulted in blocked access to over 90% of spring-run Chinook historical spawning and summer holding areas (Moyle et al. 2008). The Central Valley spring-run Chinook is limited to only three natural populations (from an estimated 17) that have consistent spawning runs (Mill, Deer, and Butte creeks), one small population on the Yuba River, and a Feather River population dependent on the Feather River Hatchery (Good et al. 2005).
In addition to historical loss and degradation of habitat, such as the Sacramento-San Joaquin Delta, an essential migratory pathway and rearing habitat that has been converted from tidal marshes and floodplains to a series of leveed islands and rip-rocked channels, Central Valley spring-run Chinook salmon must contend with the extensive habitat modification. Although the natal tributaries do not have large impassable dams like many Central Valley streams, they do

have many small hydropower dams and agricultural and municipal water diversions that have greatly reduced or eliminated in-stream flows during spring-run migration periods. During times of low or no flows, some individuals may be blocked from their natal streams and forced to remain in main rivers where breeding habitat is marginal.

The Feather River Hatchery is viewed as a major threat to the genetic integrity of the remaining wild spring-run Chinook salmon population. There is concern that interbreeding of wild Central Valley spring-run Chinook salmon with both wild and hatchery fall-run Chinook salmon has the potential to adversely affect the adaptive genetic distinctiveness of the few remaining naturally reproducing populations (CDFG 1995). While spring- and fall-runs of Chinook salmon were historically isolated in the past, the access to historical spawning areas of the Central Valley spring-run ESU in the upper tributaries has been eliminated by the construction of dams. This forces spring-run salmon to spawn in lower elevation areas also used by fall-run fish, likely resulting in hybridization of the two races. Further, the Feather River Hatchery spring-run salmon program releases their fish far downstream of the hatchery (in San Pablo Bay), which causes increased rates of straying adults migrating back upstream (CDFG 2001). However, recent efforts by CDFW have reduced straying, and, therefore, the potential for hybridization (McReynolds et al. 2006).

Other threats to Central Valley spring-run Chinook salmon in the migration corridor include unscreened or inadequately screened water diversions, predation by non-native species, effects from urbanization and rural development, logging, agriculture, and estuarine alteration, and excessively high water temperatures from decreased water flows (Moyle et al. 2008).

Recovery
A final recovery plan for the threatened Central Valley spring-run Chinook salmon ESU was issued by NMFS in July 2014 (NMFS 2014). Eleven Priority 1 and 15 Priority 2 recovery actions were developed for Central Valley spring-run Chinook salmon on the mainstem San Joaquin River. None of the recovery actions apply to the RSFS Facility Project.

3.2.3 Central Valley Steelhead DPS

The Central Valley steelhead ESU was listed as threatened under ESA on March 19, 1998 (63 FR 13347). The ESU for the species included all naturally-produced anadromous and non-anadromous steelhead (rainbow trout) and their progeny in the Sacramento-San Joaquin River Basin. Because an ESU can also include non-anadromous rainbow trout, the ESU was changed in 2005 to a DPS, which included only the anadromous forms (Moyle et al. 2008). NMFS published a final 4(d) rule governing "take" of the species on July 10, 2000 (65 FR 42422). On January 5, 2006, NMFS issued final determinations regarding the California Central Valley steelhead DPS, retaining its listing as threatened (74 FR 834).

Critical Habitat

Critical habitat for Central Valley steelhead was initially designated on February 16, 2000 (65 FR 7764). The critical habitat designation was challenged in *National Association of Homebuilders v. Evans* as having inadequately considered the economic impacts of the critical habitat designations. NMFS sought approval from the court for a consent decree to withdraw the critical habitat designations and upon approval by the Court, the designations were vacated. Following a re-evaluation of the economic impacts of the critical habitat designations, a final rule re-designating critical habitat for the Central Valley steelhead was issued on September 5, 2005 (70 FR 52488). Critical habitat for Central Valley steelhead includes 2,308 miles (3,693 km) of streams and 254 mi2 (655 km^2) of estuarine habitat. Counties with critical habitat designations include Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solano, Colusa, Yuba, Sutter, Trinity, Alameda, San Joaquin, and Contra Costa. Waters adjacent to the Project (Sand Mound Slough, Rock Slough from the confluence of Rock Slough and Sand Mound Slough to Old River, and Dutch Slough) are within the designated critical habitat for Central Valley steelhead; however, Rock Slough from the Extension to the confluence of Sand Mound Slough is not within steelhead critical habitat (B. Oppenheim, NMFS, pers. com. October 16, 2015).

The PCEs for Central Valley steelhead DPS include the following:

- Freshwater spawning sites;
- Freshwater rearing sites;
- Freshwater migration corridors;
- Estuarine areas;
- Nearshore marine areas; and
- Offshore marine areas.

Trends

The Central Valley steelhead DPS includes all naturally spawned populations of steelhead in the Sacramento and San Joaquin rivers and their tributaries, excluding San Francisco and San Pablo bays and their tributaries. Two artificial propagation programs are considered part of the DPS, the Coleman National Fish Hatchery and Feather River Hatchery steelhead hatchery programs. Although the historic distribution is not well known, the Central Valley steelhead DPS appeared to once have been widespread throughout the Central Valley and was likely to have occurred from the McCloud River and other northern tributaries of the Sacramento River to Tulare Lake and the Kings River in the southern San Joaquin Valley (McEwan 2001, Good et al. 2005). The present distribution of Central Valley steelhead DPS is greatly reduced from their historical range, mostly due to impassable barriers to spawning and rearing habitat. Estimates of the loss of habitat for Central Valley salmonids range from 80 to 95% (Clark 1929 as cited in NMFS 2009b, Yoshiyama et al. 2001, Lindley et al. 2006). In the 1960s, the entire Central Valley steelhead run (including San Francisco Bay tributaries) was estimated to be 40,000 adult steelhead (CDFG 1965). In 1996 NMFS estimated the total run size of Central Valley steelhead to be less than 10,000 fish (NOAA 2014). Steelhead are now generally restricted to a few remaining free-flowing tributaries and to stream reaches below large dams. During wet years a few steelhead may also spawn in intermittent streams. The Upper Sacramento River and tributaries, Mill, Deer, and Butte creeks, and the Feather, Yuba, American, Mokelumne, and Calaveras rivers support non-hatchery stocks with anadromous components (McEwan 2001).

Life History

Steelhead is a name used for anadromous rainbow trout, a salmonid species native to western North America and the Pacific Coast of Asia. In North America, steelhead inhabit drainages along the Pacific Coast from Southern California to Alaska, including tributaries to the San Francisco Estuary. Steelhead in California are classified as the coastal subspecies *O. mykiss irideus* (Behnke 1992).

The life history and reproductive strategies of Central Valley steelhead DPS are quite flexible to allow for persistence in the highly variable conditions within the stream systems of California's Central Valley (McEwan 2001). Generally, fish are hatched in freshwater, spend one to three years in their natal streams before becoming smolts, and then emigrate to the Pacific Ocean where most of their growth occurs. Individual fish or populations may revert to residency in the stream when flow conditions block access to the ocean. Central Valley steelhead are "winter" steelhead, referring to the seasonal period when most of the upstream adult migration occurs. Winter steelhead mature in the ocean and will migrate upstream after one to four growing seasons at sea (Burgner et al. 1992). Most winter steelhead are in advanced stages of gonadal development when they begin their migration and frequently spawn shortly after entering a freshwater river or stream (Leidy 2000). However, a few immature (summer) steelhead also migrate upstream from the ocean (Leidy 2000). Summer steelhead are stream maturing fish and spawn after several months in the stream. Migration of adult Central Valley steelhead from the ocean to spawning grounds occurs from July through March, peaking in abundance near the end of September, and the peak spawning period occurs from December through April (McEwan 2001). The peak migration of juvenile steelhead through the Delta occurs between February and April (DWR 2000). The timing of migration depends upon rainfall and consequent stream discharge being suitable for passage into upper sections of watersheds (Moyle et al. 2008). After spawning, steelhead may return to the ocean and spawn the following year (Leidy 2000).

Female steelhead construct redds with their tails in gravel and cobble substrate into which they deposit their eggs (Leidy 2000). Female steelhead produce between 200 and 12,000 eggs, with larger females producing more eggs (Scott and Crossman 1973, Moyle 2002). Eggs are deposited into the redd by the female and fertilized by the male. Fertilized steelhead eggs require clean gravel and cobble substrate, cold, well oxygenated water, and sufficient current to remove metabolic wastes. Optimal spawning temperatures are 4 to 11°C (39 to 52°F), with embryos starting to die at 13°C (55°F) (McEwan and Jackson 1996). The incubation period for eggs is related to the water temperature in the redd, and embryos may incubate anywhere from 18 to 80 days (Moyle et al. 2008). Steelhead eggs in the Central Valley hatch in about 30 days at 10.6°C (51°F) (Leitritz and Lewis 1976). Fry typically emerge from the gravel four to six weeks after hatching, but timing can be increased or retarded by factors such as redd depth, gravel size, siltation, and temperature (Shapovalov and Taft 1954 as cited in NMFS 2009b). Newly emerged fry school together and move to shallow, protected areas associated with stream margins (Royal 1972, Barnhart 1986). Older juveniles maintain territories in faster and deeper locations in pool habitats, preferring more complex habitat characterized by large physical structures such as boulders, undercut banks, and large woody debris (Moyle et al. 2008).

Within one to four years (usually two years), steelhead migrate downstream as “smolts” (juvenile fish which can survive the transition from freshwater to salt water) (Moyle et al. 2008). Juveniles may reach smolt size at an earlier age when they inhabit warmer and more productive streams (Moyle et al. 1995). Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows. Emigrating Central Valley steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean. Some juvenile steelhead may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to their final emigration to the sea. Moyle (2002) reports that juvenile steelhead feed on estuarine invertebrates and marine krill after leaving their natal streams and Merz (2002) reports that yearling steelhead feed mostly on aquatic insects. Once they increase in size, fish become a more important part of their diet (Moyle 2002). Hallock et al. (1961) as cited in NMFS 2009b found that juvenile steelhead in the Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall. Nobriga and Cadrett (2003) also have verified these temporal findings based on analysis of captures at Chipps Island and Suisun Bay.

Adult Central Valley steelhead move through the Estuary during upriver migration from July through March with peaks in September and February, while juveniles can be present all year.

Factors Affecting Central Valley Steelhead DPS

Factors contributing to the population decline of Central Valley DPS steelhead include barriers to passage during migration, water diversions, flow fluctuations, sub-optimal water temperatures for incubation and juvenile rearing, sedimentation of spawning habitat, and low summer flows for emigration (Leidy 2000). Migrating steelhead populations within the Suisun Bay/Marsh are threatened by altered flows and mortality associated with trapping, loading, and trucking fish at state and federal pumping facilities (Leidy 2000). Dredging and disposal of dredging material may also adversely affect steelhead habitat and interfere with migration, foraging, and food availability (LTMS 1996).

Recovery

A final recovery plan for the threatened Central Valley DPS steelhead was issued by NMFS in July 2014 (NMFS 2014). Eleven Priority 1 and 16 Priority 2 recovery actions were developed for Central Valley steelhead on the mainstem San Joaquin River. None of the recovery actions apply to the RSFS Facility Project (NMFS 2014).

3.2.4 Southern DPS of North American Green Sturgeon

On June 6, 2006, the southern DPS of the North American green sturgeon was listed as threatened under ESA (71 FR 17757). In 2003, after completion of its ESA status review, NMFS determined that the green sturgeon was comprised of two DPSs: the northern coastal DPS consists of populations in coastal watersheds northward of, and including, the Eel River and the southern DPS is found in the Sacramento River and adjacent coastal waters (68 FR 4433). On July 2, 2010 NMFS issued an ESA Section 4(d) rule to apply take prohibitions for southern DPS green sturgeon (75 FR 30714).

Critical Habitat

Critical habitat for the southern DPS of green sturgeon was designated on October 9, 2009 (74 FR 52300). Southern DPS green sturgeon critical habitat includes coastal U.S. marine waters within 60 fathoms (fm) depth from Monterey Bay, California (including Monterey Bay, north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; the lower Columbia River estuary; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor). This critical habitat includes 320 miles of freshwater river habitat, 897 mi^2 of estuarine habitat, and 29,581 $miles^2$ of marine habitat (74 FR 52300). Rock Slough is not within designated critical habitat. Waters near the Project Area (Sand Mound Slough and Dutch Slough) are within the designated critical habitat for southern DPS of green sturgeon (B. Oppenheim, NMFS, pers. com. July 20, 2015).

The PCEs essential for the conservation of the southern DPS of green sturgeon were described for freshwater riverine, estuarine, and coastal marine areas (74 FR 52324). Because the Project is located in the San Francisco Bay-Delta Estuary, only the riverine and estuarine PCEs are discussed here.

The specific PCEs essential for the conservation of the southern DPS of green sturgeon in riverine areas systems include:

- Food resources—abundant prey items for larval, juvenile, subadult, and adult life stages;

- Substrate type or size (i.e., structural features of substrates)—Substrates suitable for egg deposition and development and for subadult and adult and adult holding;
- Water flow—a flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages. Successful migration of adult green sturgeon to and from spawning grounds is also dependent on sufficient water flow. Spawning success is associated with water flow and water temperature. Post-spawning downstream migrations are triggered by increased flows;
- Water quality—Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;
- Migratory corridor—A migratory pathway necessary for the safe and timely passage of Southern DPS fish within riverine habitats and between riverine and estuarine habitats (e.g., an unobstructed river or dammed river that still allows for safe and timely passage);
- Water depth—Deep (≥5 m) holding pools for both upstream and downstream holding of adult or subadult fish, with adequate water quality and flow to maintain the physiological needs of the holding adult or subadult fish;
- Sediment quality—Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

The specific PCEs essential for the conservation of the southern DPS of green sturgeon in estuarine areas include:

- Food resources—abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages. Prey species for juvenile, subadult, and adult green sturgeon within bays and estuaries primarily consist of benthic invertebrates and fish, including crangonid shrimp, burrowing thalassinidean shrimp (particularly the burrowing ghost shrimp), amphipods, isopods, clams, annelid worms, crabs, sand lances, and anchovies. These prey species are critical for the rearing, foraging, growth, and development of juvenile, subadult, and adult green sturgeon within the bays and estuaries;
- Water flow—within bays and estuaries adjacent to the Sacramento River (i.e., the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco Bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds. Sufficient flows are needed to attract adult green sturgeon to the Sacramento River to initiate the upstream spawning migration;
- Water quality—Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages. Suitable water temperatures for juvenile green sturgeon should be below 24°C (75.2°F). At temperatures above 24°C (75.2°F), juvenile green sturgeon exhibit decreased swimming performance (Mayfield and Cech 2004) and increased cellular stress (Allen et al. 2006);
- Migratory corridor—a migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats;

- Water depth—A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages;
- Sediment quality—Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

Trends

There is little information about changes in the abundance of the southern DPS green sturgeon. Salvage records show before 1986, the average number of southern DPS green sturgeon salvaged per year at the two South Delta export facilities combined was 1,621; from 1986 on, the average per year was fewer than 100 (70 FR 17386–17401). Additional limited information on the numbers of southern DPS green sturgeon comes from incidental captures by a CDFW sturgeon tagging program to monitor white sturgeon (NMFS 2008). Using comparison ratios of white sturgeon to green sturgeon captures, CDFW estimated abundance of adult and sub-adult southern DPS green sturgeon between 1954 and 2001 ranged from 175 fish to more than 8,000, with an average of 1,509 fish per year. However, due to biases and errors, CDFW does not consider these estimates reliable. The southern DPS is at risk of becoming endangered throughout all of its range as the Sacramento River contains its only known population (NMFS 2008). It is believed that the green sturgeon population in the Sacramento River has declined over the last two decades; less than 50 spawners have been sighted annually even in the best spawning habitat along the middle section of the Sacramento River (Israel and Klimley 2008).

Life History

The green sturgeon is an anadromous, long-lived, slow-growing cartilaginous fish which utilizes riverine, estuarine, and marine environments throughout its lifecycle (Moyle 2002). Sturgeons are among the largest and most ancient of bony fish. Sturgeon have no scales; instead they have rows of bony plates called scutes, which serve as armor or protection. Sturgeon are highly adapted for preying on benthic animals, which they detect with a row of extremely sensitive barbells on the underside of their flattened snouts. Green sturgeon can reach over 2.1 m (7 ft) in length and weigh up to 159 kg (350 lb) (Moyle 2002).

San Francisco Bay, San Pablo Bay, Suisun Bay, and the Delta support the southernmost reproducing population of southern DPS green sturgeon. During spawning migrations, adult southern DPS green sturgeon pass through the San Francisco Bay Estuary and the Sacramento-San Joaquin Delta on their way to spawning grounds in the Sacramento River (NMFS 2002, Moyle 2002). The predominant spawning area of the southern DPS is in the upper Sacramento drainage; spawning has been reported in the mainstem as far north as Red Bluff. Spawning times in the Sacramento River are presumed to be from March through July, peaking from mid-April to mid-June. Adult sturgeon are in the river, presumably spawning, when temperatures range from 7.8–13.9°C (46–57°F). Spawning is believed to occur every two to five years (Moyle 2002).

The preferred spawning substrate for southern DPS green sturgeon is large cobble, usually from 2.5–12.7 cm (1–5 in.) in diameter, but substrates range from clean sand to bedrock. Eggs are broadcast spawned and likely adhere to substrates or settle into crevices of river bedrock or under gravel. Eggs are externally fertilized in relatively high water velocities and at depths of less than 3 m (10 ft). Female green sturgeon produce 60,000 to 242,000 eggs, each approximately 3.8 mm (0.15 in.) in diameter (Van Eenennaam et al. 2006). Eggs hatch approximately 196 hours after spawning, and larvae are 7.6–17.8 mm (0.3– 0.7 in.) long. Cech et al. (2000) reported that temperatures above 20°C (68°F) are lethal to embryos and temperatures above 24°C (75.2° F) significantly reduce five-day larval growth rates. Southern DPS green sturgeon larvae have poor swimming ability and exhibit a strong drive to remain in contact with structure, preferring cover and dark habitats (70 FR 17386). Larvae begin to feed at 10 days post hatch and complete metamorphosis into juveniles at 45 days (Adams et al. 2002). Adult sturgeon favor larger, faster moving mainstems of rivers (Mora et al. 2009), and have been documented to move through the Delta and into Suisun Bay (Kelly et al. 2007). However, the primary known breeding populations spawn in the deep pools and fast flowing reaches further upstream in the upper Sacramento River system (Poytress et al. 2010). It is not known whether green sturgeon spawn in Suisun Bay, but some spawning may take place (or previously may have taken place) in the lower San Joaquin River. Young green sturgeon have been collected at Brannan Island State Recreational area (Moyle 2002), north of the Project on the San Joaquin River. After spending some time rearing in the upper river, young sturgeon are known to migrate to migrate to estuaries in their first year and may be present in Suisun Bay (Kelly et al. 2007).

Juvenile southern DPS green sturgeon rear throughout San Francisco and San Pablo bays, the Sacramento-San Joaquin Delta, and the Sacramento River. Optimal temperatures for juvenile green sturgeon are between 19 and 24 °C (66°F and 75°F) (Allen et al. 2006). Both juveniles and adult southern DPS green sturgeon are benthic feeders; juveniles are known to consume small fish and amphipods, while adults eat fish, shrimps, mollusks, and other large invertebrates. Juveniles in the Delta feed on opossum shrimp (*Neomysis mercedis*) and amphipods (*Corophium* spp.). Juvenile southern DPS green sturgeon spend one to four years in fresh and estuarine waters (Beamsesderfer and Webb 2002) then widely disperse in the ocean after their out-migration from freshwater (Moyle et al. 1992). Juveniles migrate to sea primarily during summer and fall.

Juveniles range in size from 2–150 cm TL (0.8–59.1 in.). Green sturgeon grow approximately 7.6 cm (3 in.) per year until they reach maturity at 1.2 to 1.5 m (4 to 5 ft) in length, around age 15–20. Thereafter, growth slows down. The largest fish are thought to be 42 years old, but this estimate is likely low, and maximum ages of 60–70 or more are likely (Moyle 2002). Although adults can reach 159 kg (350 lb), in San Francisco Bay, most are less than 45.5 kg (100 lb). Typically, the largest green sturgeon are females and fish measuring over 78.7 in. long are virtually all female (SWRCB 1999).

Juvenile and adult southern DPS green sturgeon can be present in San Francisco Bay Estuary year round (NMFS 2008).

Factors Affecting Southern DPS of the North American Green Sturgeon

The principal threat to southern DPS green sturgeon is the reduction of available spawning habitat. Results of habitat assessments indicate that the geographic extent of spawning has been reduced as a result of construction of impassable barriers (e.g., Keswick and Shasta dams) in the upper Sacramento River. Potential adult migration barriers to green sturgeon include the RBDD, Sacramento River Deep Water Ship Channel locks, Fremont Weir, Sutter Bypass, the Delta Cross Channel gates on the Sacramento River, and the Shanghai Bench and Sunset Pumps on the Feather River. Additional threats to the abundance and distribution of green sturgeon include insufficient flow rates, increased water temperatures from reduced flows, water diversion, non-native species, poaching, by-catch of green sturgeon in fisheries, pesticide and heavy metal contamination, and local fishing.

Low flow rates likely reduce survival and production of the southern DPS green sturgeon by hindering the dispersal of larvae to areas of greater food availability and suitable habitat, delaying the transportation of larvae downstream from water diversions, and decreasing nutrient supply to their nurseries (CDFG 1992).

The introduction and rapid colonization of the estuary by invasive fish and macroinvertebrates is thought to have affected native species, including the green sturgeon. For example, the nonnative Asian overbite clam *Corbula amurensis*, introduced in 1986, has become the most common food of white sturgeon and was present in the diet of southern DPS green sturgeon (CDFG 2002). Larval and juvenile sturgeon are susceptible to predation by nonnative fish, including both striped bass and largemouth bass, inhabiting the Estuary. The significance of the positive and adverse effects of nonnative species on the population dynamics of various life stages of green sturgeon has not been determined.

In the Delta, a major factor negatively affecting juvenile and adult southern DPS sturgeon abundance may be harvest in the recreational sport fisheries. When harvest rates are high, population recovery is slow because of the adult southern DPS green sturgeon's slow growth rate, long life span, and age at first spawn. Protective measures have been implemented by CDFW prohibiting fishing for sturgeon year-round on the Sacramento River from the Keswick Dam to the Hwy 162 Bridge. Additionally, CDFW has conducted investigations since 2003 into sturgeon poachers on the Sacramento River and a number of arrests have been made on operations that were catching large numbers of white sturgeon to sell. It is illegal to remove green sturgeon from the water and if caught they must be returned to the water immediately.

Recovery

On November 12, 2009, NMFS announced its intent to prepare a Recovery Plan for the southern DPS of the North American green sturgeon.

A Federal Recovery Outline was published in December 2010 that listed several threats to the recovery of green sturgeon (NMFS 2010). These threats include the following:

- Blockage of access to spawning habitat on the Sacramento, Feather, and Yuba rivers;
- Deleterious hydrograph and water temperature regimes below Keswick and Oroville dams;
- Fisheries bycatch and discard, illegal retention in recreational fisheries, and poaching;
- Activities that impact spawning, rearing, and feeding habitats;
- Entrainment or impingement at water diversions, ocean energy projects, and vessel strikes;
- Exposure to contaminants; and
- Loss of estuarine/Delta function.

Key recovery needs and implementation measures include the following:

- Additional spawning and egg/larval habitat;
- Restore access to suitable habitat;
- Improve potential habitat;
- Establish additional spawning populations;
- Ensure adequate spatial separation of spawning populations; and
- Ensure all spawning populations are of sufficient size to meet genetic diversity criteria.

Several research and monitoring programs were also recommended in the Recovery Outline.

3.2.5 Delta Smelt

Delta smelt was listed as threatened under ESA on March 5, 1993 (58 FR 12854). In 2006, the USFWS was petitioned to upgrade the status from threatened to endangered; on April 7, 2010 the USFWS announced in their status review finding that although the reclassification of delta smelt from threatened to endangered was warranted, it was precluded by other higher-priority listing actions (75 FR 17667). No special 4(d) rules for delta smelt currently exist.

Critical Habitat

Critical habitat was designated for delta smelt on December 19, 1994 and became effective January 18, 1995 (59 FR 65256-65279). Critical habitat includes areas of all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Carquinez Strait, Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma Sloughs; and the Sacramento-San Joaquin River Delta, as defined in Section 12220 of the California Water Code of 1969 (a complex of bays, dead-end sloughs, channels typically less than 4 m [13.1 ft] deep, marshlands, etc.). Counties with critical habitat designation include Contra Costa, Sacramento, San Joaquin, Solano, and Yolo (USFWS 1994). Rock Slough and the waters adjacent to the Project Area are within the designated critical habitat for delta smelt.

The PCEs for delta smelt include the following:

- Spawning Habitat — delta smelt adults seek shallow, fresh, or slightly brackish backwater sloughs and edgewaters for spawning. To ensure egg hatching and larval viability, spawning areas also must provide suitable water quality (i.e., low concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emergent vegetation). Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay. The spawning season varies from year to year and may start as early as December and extend until July;

- Larval and Juvenile Transport—To ensure that delta smelt larvae are transported from the area where they are hatched to shallow, productive rearing or nursery habitat, the Sacramento and San Joaquin rivers and their tributary channels must be protected from physical disturbance (e.g., sand and gravel mining, diking, dredging, and levee or bank protection and maintenance) and flow disruption (e.g., water diversions that result in entrainment and in-channel barriers or tidal gates). Adequate river flow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay. Additionally, river flow must be adequate to prevent interception of larval transport by the State and Federal water projects and smaller agricultural diversions in the Delta. To ensure that suitable rearing habitat is available in Suisun Bay, the 2 parts per thousand (ppt) isohaline must be located westward of the Sacramento-San Joaquin River confluence during the period when larvae or juveniles are being transported, according to the historical salinity conditions which vary according to water-year type;
- Rearing Habitat — Maintenance of the 2 ppt isohaline according to the historical salinity conditions described above and suitable water quality (low concentrations of pollutants) within the Estuary is necessary to provide delta smelt larvae and juveniles a shallow, protective, food-rich environment in which to mature to adulthood. This placement of the 2 ppt isohaline also serves to protect larval, juvenile, and adult delta smelt from entrainment in the State and Federal water projects. An area extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat. Three Mile Slough represents the approximate location of the most upstream extent of tidal excursion when the historical salinity conditions described above are implemented. Protection of rearing habitat conditions may be required from the beginning of February through summer;
- Adult Migration — Adult delta smelt must be provided unrestricted access to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento River and San Joaquin River channels and their associated tributaries, including Cache and Montezuma sloughs and their tributaries. These areas also should be protected from physical disturbance and flow disruption during migratory periods.

In accordance with Section 4(b)(8) of the ESA, the USFWS included in its proposed critical habitat designation (1994) a brief description and evaluation of those activities (public or private) that may adversely modify such habitat or may be affected by such designation, including:

- Central Valley Project operations, State Water Project operations, deep water navigation channel dredging, reoperation of Folsom Dam, Oroville Dam, and Auburn Dam, Central Valley and State Water Project Wheeling Purchase Agreement, San Joaquin Valley

Drainage Program, Central Valley Project water contract renewals, petition by the Bureau for a change in diversion point, South Delta Water Management, South Delta Temporary Barriers Project, Stanislaus-Calaveras River Basin Water Use Program, Phases 3 and 4 of the Suisun Marsh Project, North Delta Water Management Project, West Delta Water Management Project, Delta Wetlands Water Storage Project, Los Banos Grandes Reservoir, Los Vaqueros Reservoir, Kern Water Bank, full operation of four State Water Project pumps, entrainment of fish and thermal pollution by industry (e.g., power generation facilities), urban or agricultural nonpoint contaminant discharges, in-Delta and Suisun Marsh water diversion, Phase 2 of the Coastal Aqueduct, and the Delta Levee Subvention Program.

Prior to publication of the final critical habitat designation, the USFWS determined through Section 7 consultations that the South Delta Temporary Barriers Project, deep water navigation channel dredging, Los Vaqueros Reservoir Project, and Phase 2 of the Coastal Aqueduct Project would not jeopardize the delta smelt. In the final critical habitat designation (1995), the USFWS identified five general activities that, depending on the season of construction and scale of the project, might result in the destruction or adverse modification of critical habitat without necessarily jeopardizing the continued existence of the delta smelt. These activities were:

1. Sand and gravel extraction in river channels or marshes.
2. Diking wetlands for conversion to farmland and dredging to maintain these dikes.
3. Levee maintenance and bank protection activities, such as riprapping, removal of vegetation, and placement of dredged materials on levees of banks.
4. Operation of the Montezuma Slough Control Structure.
5. Bridge and marina construction.

Trends

Historically, delta smelt occurred from San Pablo Bay upstream to the City of Sacramento on the Sacramento River and Mossdale on the San Joaquin River (Moyle et al. 1992), and, as recently as 30 years ago, were one of the most common and abundant species in the Delta. Survey data indicate that the population of delta smelt has declined substantially since the 1970s. Juvenile delta smelt have virtually disappeared from the Delta in areas south of the San Joaquin River (Miller 2000, CDFG 2003, Fleming and Nobriga 2004). Currently, delta smelt are primarily found from Suisun Bay upstream through the Delta in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties.

A relative abundance index has been developed for delta smelt using two long-term surveys conducted by CDFW; the Summer Townet Survey and the Fall Midwater Trawl Survey. The Summer Townet Survey began in 1959 and provides the longest historical record of delta smelt abundance. The Fall Midwater Trawl Survey began in 1967 and covers nearly the entire range of delta smelt distribution. Delta smelt population assessments have been based on the abundance index trends from these surveys.

Based on the relative abundance indices, significant changes in delta smelt population occurred in 1975–1976, 1980–1981, and 1998–1999 (Manly and Chotkowski 2006). The 1980–1981 Fall Midwater Trawl abundance index revealed a population decline of more than 80% (Figures 25 and 26) and was one of the factors that lead to the listing of delta smelt as a threatened species in

1993 (58 FR 12854, Moyle 2002). During the decade from 1983 to 1993, the abundance index remained consistently low. Drought from 1987 to 1992 severely impacted the delta smelt numbers. From 1991 to 2001, delta smelt abundance fluctuated widely (Figures 25 and 26). The population rebounded somewhat in the 1990s, however delta smelt numbers have trended sharply downward since about 1999 (Reclamation 2008). In 2002, delta smelt and three other pelagic Delta fish (longfin smelt, threadfin shad, and striped bass) declined significantly, with delta smelt abundance indices trending to record lows from 2002–2008 (Armor et al. 2005, Baxter et al. 2008). In 2005, both the Fall Midwater Trawl Survey and the Summer Townet Survey fell to new lows and have stayed low since (Figures 24 and 25). The 2014 Fall Midwater Trawl index of nine was the lowest on record. The 2014 Summer Townet Survey index was 0.5, the third lowest index on record.

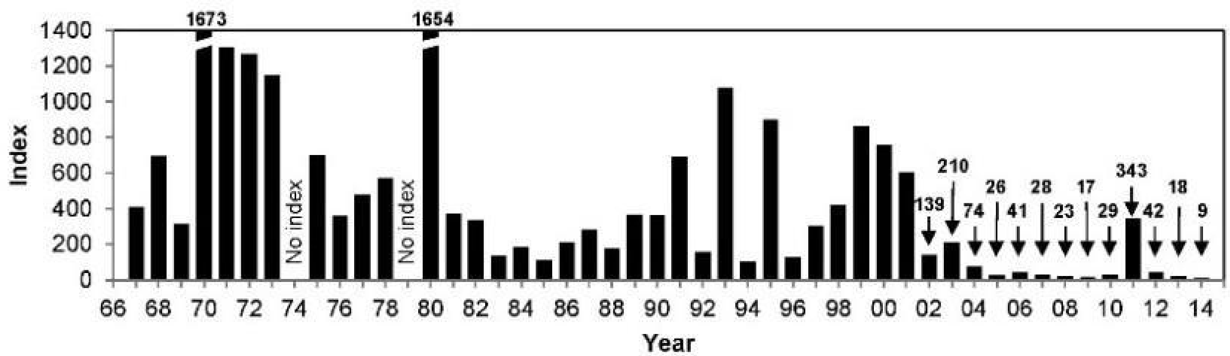


Figure 25 Annual Indices for delta smelt from Fall Midwater Trawl Survey (1967-2014)[8]

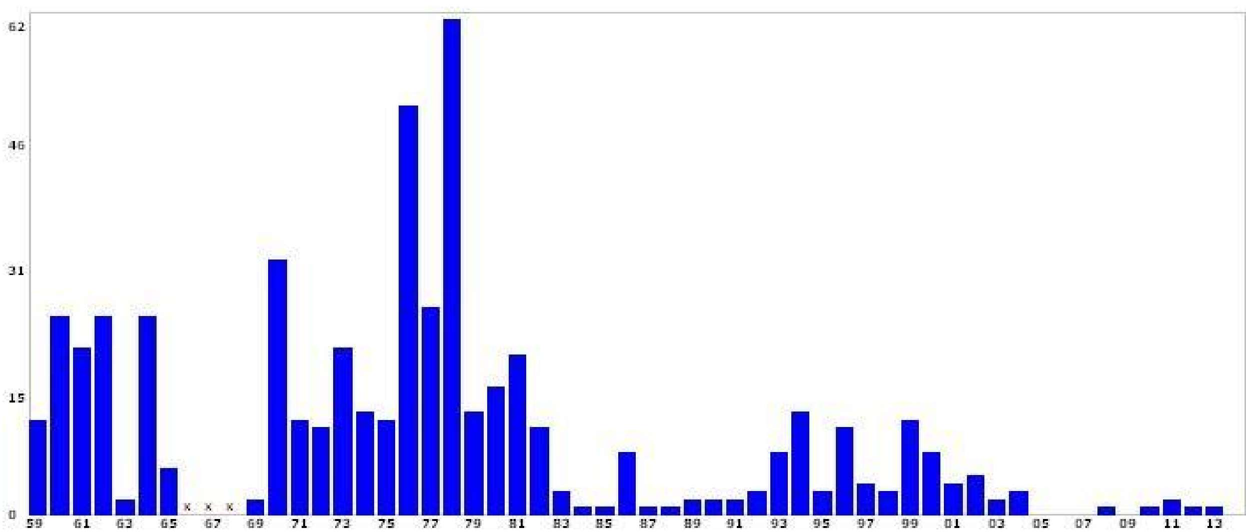


Figure 26 Annual Indices for delta smelt from Summer Townnet Survey (1959-2014)[8]

The reasons for the persistently low abundance since 1982 are thought to result from multiple interacting factors including larval transport during high flows in winter–spring 1982 and 1983, a

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[8] Sources: CDFW http://www.dfg.ca.gov/delta/data/townet/indices.asp?species=3. Retrieved on April 10, 2015. http://i1.wp.com/mavensnotebook.com/wp-content/uploads/2015/01/FMWT-Delta-smelt-index-graphic.jpg. Retrieved on April 10, 2015.

drought during 1987–1992, entrainment in water diversions, contaminant exposures, and competition from introduced species (Moyle et al. 1992, Bennett 2005).

Life History

The delta smelt was originally classified as the same species as the pond smelt *Hypomesus olidus*, but Hamada (1961) and Moyle (1976, 1980) recognized the delta smelt as a distinct species. The delta smelt is the only smelt endemic to California and the only true native estuarine species found in the Sacramento-San Joaquin Delta (Moyle et al. 1989, Wang 1986).

Delta smelt are a small, fast-growing, short-lived schooling fish endemic to the Delta. Delta smelt are generally about 60–70 mm (2.4–2.8 in.) long, although they may reach lengths of 130 mm (5.1 in.) (Moyle 2002). A steely-blue sheen on their sides gives them a translucent appearance. Most live only one year and usually die after spawning, although two-year old smelt have been found (CDFG 2000). Delta smelt are preyed upon by a variety of predatory fish including striped bass, largemouth bass, and silverside (Bennett and Moyle 1996).

The delta smelt is a euryhaline species that spawns in freshwater although it usually inhabits water with salinities ranging from 2–10 ppt (Moyle et al. 1992). It rarely occurs in estuarine waters with more than 10 to 12 ppt salinity (Moyle et al. 1992) but has been collected from estuarine waters up to 14 ppt salinity. For a large part of its life span, delta smelt live along the freshwater edge of the mixing zone (saltwater/freshwater interface), where the salinity is approximately 2 ppt (USFWS 2002). Water temperatures seem to have little effect on the distribution of delta smelt (Moyle 2002). It is found in temperatures ranging from 6–28°C (42.8–82.4°F), although 28°C (82.4°F) is close to its lethal limit of 29°C (84.2°F) (Moyle 2002). Water temperature in the Central Delta is generally 21–24˚C (69.8–75.2) in July (Baxter et al. 2007), which is near the lethal limit for delta smelt (Swanson et al. 2000). Delta smelt abundance in this region has been inversely correlated with water clarity in summer (Nobriga et al. 2008), as well as in fall and early winter (USFWS 2008b).

Delta smelt concentrate in the upper portions of the water column in areas near the mixing zone where high abundances of its prey occur. Shortly before spawning, adult delta smelt migrate upstream during fall and winter from the brackish-water habitat associated with the mixing zone and disperse widely into river channels and tidally-influenced backwater sloughs of the eastern Delta (Moyle 2002, Wang 1991).

Spawning season and location vary from year to year, depending on water flow and associated water temperatures. Spawning has been known to occur in the lower Sacramento and San Joaquin rivers, Georgiana Slough, Montezuma Slough, and in sloughs of the Suisun Marsh. In low flow years, it appears that a significant amount of spawning takes place in the northern and western Delta. Spawning may occur from December through July, and in low outflow years, from late March through mid-May.

Fecundity is low for delta smelt compared to other California Osmeridae species; it produces only 1,247–2,590 eggs per female as opposed to 5,000–25,000 eggs for other smelt species such as longfin smelt (Moyle 1976, Moyle et al. 1992). Optimal temperatures for hatching and larval development have not been determined, although eggs and larvae have been collected in temperatures ranging from 7–22ºC (44.6–71.6ºF). The eggs are demersal and stick to substrates such as cattails and tules, tree roots, submerged vegetation, and gravel (Moyle 1976, Wang 1991). After hatching, which takes approximately 12–14 days, the semi-buoyant larvae feed just off the bottom. Newly hatched larvae are small (4.5–6 mm TL [0.18–0.24 in.]). As they mature, their swim bladder makes them more buoyant and they are carried downstream to the mixing zone where they begin feeding on unicellular algae, rotifers, and/or sub-adult copepods higher in the water column. With high densities of phytoplankton and zooplankton, larval and juvenile delta smelt grow rapidly (Moyle et al. 1992) and by August juveniles can be 40–50 mm (1.6–2.0 in.), eventually reaching 120–130 mm (4.7–5.1 in.) as adults.

Delta smelt abundance in southern Suisun Bay is relatively low especially in comparison to the northern Suisun Bay, northern Suisun Marsh, and the northern Delta, where abundances have been higher than elsewhere in the Estuary (Radtke 1966, Bennett et al. 2002). In these northern areas, post-larvae and juveniles were eight times more abundant and were relatively larger than delta smelt collected from southern Suisun Bay (Aasen 1999, Bennett et al. 2002). Delta smelt collected in the northern reaches appear in better body-condition at length, suggesting that feeding success is enhanced there relative to southern Suisun Bay (Hobbs et al. 2006). Delta smelt in southern Suisun Bay undergo vertical migrations to near-surface waters on flood tides and at depth on ebb tides.

Experiments were conducted using delta smelt of different sizes (juveniles (< 45 mm SL [1.8 in.]); subadults (45–60 mm SL [1.8–2.4 in.]), and adults (>60 mm SL [2.4 in.]) acclimated to seasonally appropriate ranges of temperatures to determine both salinity and temperature tolerances (Swanson and Cech 1995). Temperature tolerance was measured in fish acclimated to both freshwater (0 ppt) and brackish water (4 ppt) as delta smelt may exhibit season preference in salinity. Juveniles and adults are most abundant in the brackish water entrapment zone; adults move upstream to freshwater prior to spawning. Temperature tolerance limits were measured in terms of critical thermal (CT) maxima (CT max), and CT minimum (CT min). Results showed that delta smelt tolerated moderately acute temperature changes and CT max was significantly affected by acclimation temperature. Acclimation temperatures of 12°C (53.6°F), 17°C (62.6°F), and 21°C (69.8°F) corresponded respectively to CT max of 21°C (69.8°F), 25°C (77.0°F), and 28°C (82.4°F) (Swanson and Cech 1995).

Delta smelt are complex swimmers. During laboratory experiments using a Brett-type, recirculating swimming flume, delta smelt juvenile-adults were observed to alternate between three distinct swimming behaviors. Results showed that 58% (n=109) of the juvenile-adult fish were capable of maintaining moderately high swimming velocities, (0.89 fps) for 10 minutes, however, the remaining 42% were unable or unwilling to swim at velocities of 0.3–0.7 fps. At low velocities (0.3 fps [<10 cm s-1]) they utilize stroke-and-glide swimming, at higher velocities (0.5–0.7 fps [15–20 cm s-1]) they stroke continuously, while at still higher velocities (0.8–1.2 fps [25–35 cm s-1]) they transition to “burst-and-glide” swimming (Swanson et al. 1998). These three swimming behaviors correlate to sustained, prolonged, and burst speeds, respectively. Swim speeds were unrelated to fish length. Additionally, delta smelt were observed to undergo “swimming failures” when transitioning between swimming behaviors causing them to lose their position in the water column and be impinged on the back of the sampling apparatus. Most notably, this occurred around 0.5 fps (15 cm s-1) as they transitioned from stroke-and-glide to continuous swimming (Swanson et al. 1998).

Delta smelt feed on planktonic invertebrates including copepods, cladocerans, amphipods, and insect larva (Lott 1998). The primary food for all life stages of the delta smelt are copepods, including the nauplius, copepodite, copepodid, and adult stages. Adult delta smelt ate the native copepod, *Eurytemora affinis*, almost exclusively (Herbold 1987) until the 1980s when the native copepods were displaced by the introduced copepod *Pseudodiaptomus forbsii* from China and Japan; the delta smelt diet has since shifted to this nonnative species. Adult smelt will also prey on opossum shrimp *Neomysis mercedis* as a secondary food source and on cladocerans (e.g., *Daphnia* spp., *Bosmina* spp.) as a seasonal food source. The pelagic larvae of delta smelt feed on phytoplankton until they are four days old, then begin to feed on rotifers on the sixth day and *Artemis nauplii* on day 14 (Mager 1993). Within the mixing zone, the pelagic larvae are zooplanktivores and feed on rotifers, copepods, cladocerans, and amphipods. Juvenile delta smelt primarily eat planktonic crustaceans, small insect larvae, and mysid shrimp (Moyle 1976). Larval delta smelt can be present near the Project from January through June. When they reach 16 to 18 mm (0.6 to 0.7 in.) they rise up off the bottom and are washed downstream to the mixing zone (Moyle 2002). Juvenile delta smelt (greater the 30 mm [1.2 in.] FL) are present in Delta from July through December and peak in September in Suisun Bay and the West Delta. Adult delta smelt are present in Delta year round, but are found in large numbers from January through March (Baxter et. al. 1999) and move into sloughs and side channels when spawning in March and April (Moyle 2002).

Factors Affecting Delta Smelt
Reduced available habitat and increased entrainment from water exports have been identified as the primary causes for the decline of delta smelt (USFWS 1994). Prior to 1984, for at least half of the year (October through March) the mixing zone was located in Suisun Bay. Since 1984, with increasing water diversions primarily from the SWP and CVP, this zone has moved to the lower channels of the Sacramento and the San Joaquin rivers. This not only decreases the amount of habitat available for the delta smelt but also makes them more vulnerable to entrainment by the SWP and the CVP pumps. The diversions draw water across the Delta and into the channels of the San Joaquin, altering the flow patterns of the Delta. Because this diversion is downstream of the pumps, there are times when there is a net reverse flow in the waters of the lower San Joaquin River (USFWS 2009). The frequency and duration of this upstream flow has increased in recent years, especially during the delta smelt spawning period. Larvae are presumably drawn into the Delta channels where they are subject to entrainment by the SWP/CVP. On December 15, 2008, the Sacramento office of USFWS issued a BiOp on the LTO of the CVP and SWP. The USFWS determined that the continued operation of these two water projects, as described in the plan, was likely to jeopardize the continued existence of the delta smelt and adversely modify its critical habitat.

Factors contributing to the delta smelt's vulnerability to extinction include its short life span and relatively low fecundity, the introduction of exotic organisms, and water diversions which adversely modify its habitat, distribution, food supply, and abundance (CDFG 2008).

Recovery
The delta smelt was one of eight fish species addressed in the November 26, 1996 Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes (USFWS 1996). The objective of the Recovery Plan was to remove delta smelt from the Federal list of threatened species through restoration of its abundance and distribution, and removal of the threats to the species. The basic

strategy for recovery was to manage the estuary in such a way that it became a better habitat for native fish in general and delta smelt in particular. However, the USFWS has since stated that the 1996 Recovery Plan is outdated.

The USFWS completed a 5-year status review of the delta smelt on March 31, 2004 (USFWS 2005b). The review concluded that the delta smelt population remained relatively low, compared to historical levels, and that many of the threats to the species identified at the time of listing still exist, precluding de-listing of the species. Most of the postulated threats to the species, such as the presence of toxic contaminants, disease, changes in abundance and composition of food, and introduction of exotic species, are not readily remediable through the regulatory process, making the abatement of these threats problematic.

In 2009, the USFWS developed a Spotlight Species 5-Year Action Plan 2010–2014 for delta smelt (USFWS 2009). The recovery actions in the plan are intended to ameliorate the effects of limited range and population numbers and prevent extinction of the species. These actions include:

- Establish Delta outflows proportionate to unimpaired flows in the watershed. This action targets facilitation of up- and downstream movement, seasonal expansion of the low-salinity zone, increased winter and spring flows, variability in salinity, and flows to flush contaminants;
- Implement water project operations that minimize reverse flows in the Delta when the risk of entrainment into water diversions is high. This action targets increasing the area of suitable spawning habitat and minimizing losses to entrainment;
- Work with the University of California, Davis and California Department of Water Resources to establish a genetics management plan for delta smelt. This action targets loss of genetic integrity and stochastic demographic extinction;
- As of 2015, USFWS is working on a new recovery plan for delta smelt.

3.2.6 Longfin Smelt

A petition to list the San Francisco Estuary population of longfin smelt as a threatened species under the ESA was denied in 1994 (USFWS 1994) because the degree of reproductive and genetic isolation was unknown. In 2007, the USFWS was again petitioned to list the San Francisco Bay-Delta population of the longfin smelt as a DPS under ESA. The USFWS initiated a formal status review for the longfin smelt, but in April 2009 denied federal listing under ESA.

The USFWS determined that longfin smelt in the San Francisco Bay-Delta did not meet the DPS criteria, but the decision was challenged in court. On February 2, 2011, the U.S. District Court for the Northern District of California required the USFWS to complete a rangewide status review of the longfin smelt and make a new determination by September 30, 2011 on whether ESA protection was warranted. USFWS determined that while longfin smelt warrant listing, the listing was impeded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants. USFWS will develop a proposed rule to list longfin smelt as their priorities allow (USFWS 2012).

Critical Habitat

Currently, there is no critical habitat for longfin smelt or PCEs.

Trends

While USFWS is reviewing the longfin population throughout its range, this analysis discusses only the portion of the population in the San Francisco Bay-Delta. In the Bay-Delta, longfin smelt were once among the most abundant pelagic fish but in the past decade the population has fallen to unprecedented low numbers. Because of their former abundance and broad distribution, longfin smelt are believed to be an important integrator of the estuarine food web and a valuable indicator of ecosystem function (Moyle 2002).

USFWS has made preliminary estimates of adult longfin smelt abundance during fall months within the upper San Francisco Estuary based upon Fall Midwater Trawl Survey data for the period 1975–2007. The estimates suggest that abundance peaked in the “tens of millions” in 1982 and declined to the “tens of thousands” by 2007 (CDFG 2009). The abundance of longfin smelt also has declined relative to other fish, dropping from first or second in abundance in most trawl surveys during the 1960s and 1970s, to seventh or eighth in abundance. Longfin smelt numbers in the Delta declined by 90% between 1984 and 1994. The Fall Midwater Trawl Survey Index had an annual average of only 537 from 1987 through 1994, whereas in the previous 20 years it had averaged more than 17,000 a year. However, in the following year, California experienced a wet cycle and the annual index for longfin smelt rose to an average above 4,000 from 1995–2000. The trend then reversed again; from 2001–2006, the index averaged only 569 each year. The 2007 index was 13, the lowest in history. Longfin smelt numbers (relative abundance) have remained at low abundance since 2007 (Figure 27).

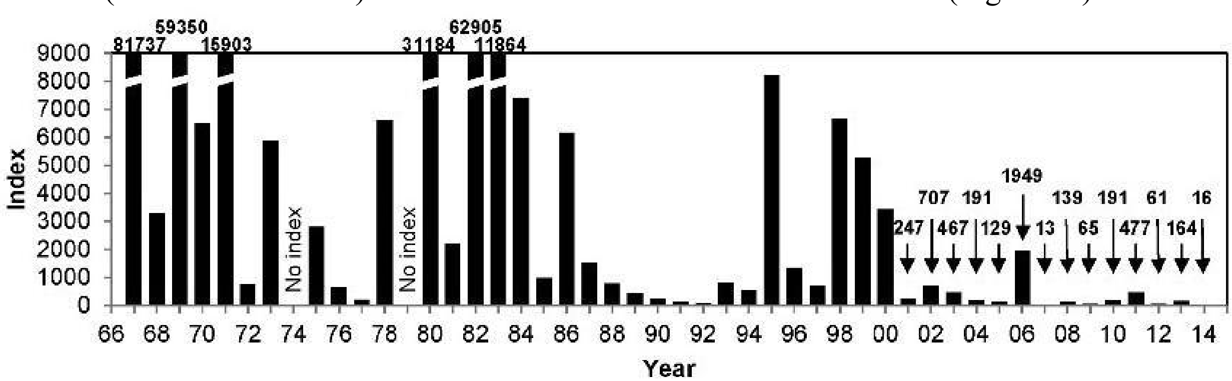

Figure 27 Annual Indices for longfin smelt from Fall Midwater Trawl Survey (1967-2014)[9]

[9] Source: http://i2.wp.com/mavensnotebook.com/wp-content/uploads/2015/01/FMWT-Longfin-smelt-index-graphic.jpg. Retrieved on April 10, 2015.

Life History

The longfin smelt is a small, anadromous fish found in California's bay, estuary, and nearshore coastal environments from San Francisco Bay north to Prince William Sound, Alaska (Moyle 2002). The San Francisco Bay-Delta supports the southern-most longfin smelt population and the largest population in California (Moyle 2002).

The longfin smelt found in California is a euryhaline, planktivorous member of the family Osmeridae. Longfin smelt are translucent silver with an olive to pinkish iridescent hue. Longfin smelt have a predominantly two-year life cycle reaching lengths of 90–124 mm (3.5–4.9 in.) FL, though some live a third year and reach maximum lengths of about 140–150 mm (5.5–5.9 in.) (Baxter 1999, Moyle 2002).

Longfin smelt migrate throughout the Bay-Delta over the course of their lifecycle (Moyle 2002), including portions of the Napa River (Stillwater Sciences 2006), Suisun and Napa marshes (Meng and Matern 2001), and the Sacramento-San Joaquin Delta (Dege and Brown 2004). Historically, they were found seasonally in all of the Estuary's major open water channels and in Suisun Marsh (Rosenfield 2010). During fall and winter months, longfin smelt numbers are greatest in the northern Estuary (particularly Suisun Bay and the western Delta) although they are also found in shallow bays such as San Pablo Bay and the South Bay during that time. During summer months, higher densities of longfin smelt are found in the Central Bay. Sub-adults probably mature sexually as they migrate towards spawning locations.

While there are a lot of unknowns about longfin smelt spawning, longfin smelt spawn primarily in freshwater, and spawning locations in the San Francisco Estuary are believed to fluctuate between Suisun Bay, Suisun Marsh, and into upper Delta reaches depending on the levels of freshwater outflows (Wang 1991, Merz et al. 2013). The longfin smelt spawning season is drawn out and timing varies somewhat from year to year but most spawning takes during December–May (Moyle 2002, Merz et al. 2013). Longfin smelt are generally semelparous, although a measurable portion of the population consistently survives into a second year.

Longfin smelt eggs are adhesive and are most likely deposited on the same type of sandy substrates used by other osmerid species (CDFG 2009). Females lay between 5,000 and 24,000 eggs. The microhabitat requirements of incubating longfin smelt embryos are largely unknown. Eggs can incubate in water temperatures of 7–14.5°C (44.6–58.1°F). At 7°C (58.1°F) embryos hatch in approximately 40 days (range 37–47 days) (Dryfoos 1965). Incubation time decreases with increasing water temperature. After hatching, larvae quickly move into the upper part of the water column and are transported downstream to nursery areas in the lower Delta and Suisun and San Pablo bays (Moyle 2002). Larvae are most abundant in the water column from January through April (CDFG unpublished, as cited in Reclamation 2008).

Depending on water temperature, metamorphosis into the juvenile form may begin as quickly as 15 days after hatching, but more commonly requires three months to complete (Emmet et al. 1991). Post-larval longfin smelt are reportedly associated with deep-water habitats (Rosenfield and Baxter 2007). In April and May, juveniles migrate downstream to San Pablo Bay.

Longfin smelt feed on planktonic invertebrates. In the Bay-Delta, the principal prey items for adult longfin smelt are believed to be opossum shrimps, *Acanthomysis* spp. and the mysid, *Neomysis mercedis*, although populations of the latter species have dropped dramatically in recent years in the Estuary (Orsi and Mecum 1996). Copepods and cladocerans are also important prey, especially for young fish; the diet expands to include mysids and amphipods as the fish grow (Dryfoos 1965).

Larval longfin smelt are present in the Delta from January through March (CDFG 2009). Juvenile longfin (greater the 40 mm [1.6 in.] FL) are present in Delta from May through December and peak in June in Suisun Bay and October and November in Suisun Bay and the West Delta. Adult longfin smelt are present in the Delta year round, but are found in large numbers from January through May (Baxter et. al. 1999).

Factors Affecting Longfin Smelt

Declines of the longfin smelt in the Sacramento-San Joaquin Estuary are due mainly to the effects of water exports from the Delta (Moyle 2002). Low flows result in upstream displacement of the productive freshwater-saltwater mixing zone, constricting the size of favorable habitat and exposing the fish to pump intakes and structures (USFWS 1994). Low flows also fail to disperse larvae downstream into productive nursery areas in Suisun Bay (USFWS 1994, Moyle et al. 1995).

Other potential threats include direct and indirect impacts of non-native species (such as clams and copepods) on the longfin smelt food supply and habitat (Moyle 2002, USFWS 1995). Pesticides applied to agricultural crops, suburban lawns, or nuisance aquatic species may have deleterious effects on developing longfin smelt embryos. Aquatic eggs and larvae of many species are sensitive to pesticides, metals, other chemicals in water and lethal effects occur even at seemingly low levels of exposure. Due to a two-year life cycle, relatively brief periods of reproductive failure could lead to extirpation (USFWS 1994).\

Recovery

There is no recovery plan, as the species is not federally listed at this time. However at the state level, CDFG (2009) listed the following seven actions that would have population benefits for longfin smelt:

- Reduce pollution of estuaries by chemicals harmful to longfin smelt and their food web;
- Reduce entrainment and loss of longfin smelt at water diversions–including diversions for cooling of power plants and diversions operated by the State Water Project, Central Valley Project, municipal entities, and for agricultural and recreational purposes. For example, moving the SWP and CVP diversions from the south Sacramento-San Joaquin Delta would reduce loss of longfin smelt to entrainment;
- Reduce entrainment and loss of adult, juvenile, and larval longfin smelt to dredging;
- Reduce predation on longfin smelt by managed non-natives fish;
- Improve and/or expand habitat for longfin smelt. For example, this could include increasing average December–May Sacramento-San Joaquin Delta outflow, restoring intertidal or shallow subtidal habitat, and/or improving habitat in the floodplain or in open water;

- Modify commercial fishery regulations to reduce loss associated with by-catch of longfin smelt;
- Adaptively manage the scientific collection of longfin smelt.

3.2.7 Giant Garter Snake

The giant garter snake was formally listed as threatened under ESA in October 1993 (58 FR 54053). In 2006, USFWS evaluated whether the giant garter snake was still in danger and recommended no change in its threatened status. The primary threat to giant garter snake populations continues to be loss and fragmentation of habitat from urban and agricultural development and loss of habitat associated with changes in rice production in the state.

Critical Habitat
Giant garter snake does not have any designated critical habitat at this time.

Occurrence On or Adjacent to the Project Site
The California Natural Diversity Database (CNDDB) shows the nearest recorded sighting of giant garter snake to the Project Area occurred approximately 5.22 miles north of the RSFS Facility at the mouth of the Sacramento River-San Joaquin River Delta. The snake was seen in 2014 (Occurrence #359) crossing a levee road on Reclamation District 2026 property (Webb Tract). A second occurrence in the same general area at the southern end of Fisherman's Cut between Webb Tract and Bradford Island is documented by the CNDDB in 2002 (Occurrence #170). Additional sightings have been reported at the north end of the Antioch Bridge in 2010 (Occurrence #298) and at the horseshoe bend between Decker and Sherman islands south of the Brannan Island State Recreational Area in 1998 (Occurrence #150), 6.9 miles and 8.4 miles northwest of the Project Area, respectively. The only personal observation of giant garter snake by an Olberding Environmental biologist occurred in 2012 when a giant garter snake was observed crossing from Ryer Island to Prospect Island in Miner Slough, which is roughly 19.3 miles north of the RSFS Facility. Two additional sightings (Occurrence #151 in 1996 and

Occurrence #307 in 2010) were located approximately 8.3 miles east of the Project Area around Medford Island, which is west of Stockton.

All of these sightings were in locations that have connectivity to Rock Slough through either Sand Mound Slough or Holland Cut. Giant garter snakes are typically absent from large waterways and may have difficulty crossing the wider sections of the Sacramento or San Joaquin rivers.

The only two USFWS recognized extant populations of giant garter snake close to the Project are the two Delta populations: Badger Creek and White Slough. The Badger Creek population is located near the Cosumnes River Preserve approximately 20 miles south of Sacramento and the White Slough population is within the White Slough Wildlife Area approximately eight miles west of Lodi. These established populations of giant garter snake are approximately 20 miles north and 16 miles east of Rock Slough; however, individuals and small, unstable, or unknown populations may exist closer to the Project Area (available survey data are lacking).

Olberding Environmental biologists conducted extensive surveys and monitored construction activities in the Canal downstream of the RSFS in 2014 and 2015 as a part of the CCWD Segment 2 Canal Replacement Project. No giant garter snakes were observed within the Canal during daily visits by biologists. No giant garter snakes were observed during annual surveys at the Holland Tract Preserve property during monitoring efforts from 2012 – 2014. The Preserve is located 1.3 miles east of the RSFS at the confluence of Sand Mound Slough and Rock Slough. The most recent survey, conducted specifically for giant garter snake, occurred in November 2015 during mechanical harvesting of invasive aquatic weeds at the RSFS Facility. Again, no evidence of giant garter snakes was found. This lack of observational data of giant garter snake within the immediate vicinity of the RSFS Facility, along with the marginal giant garter snake habitat quality at the end of Rock Slough immediately surrounding the fish screen, and the presence of large predatory fish within Rock Slough, suggests that it would be highly unlikely to encounter giant garter snake within the Project Area.

Trends

Giant garter snake is now apparently absent from an estimated 98% of its former habitat in the San Joaquin Valley. Giant garter snake is listed as a threatened species due to loss of habitat and heavy predation by introduced fish. This snake's habitat has been destroyed and is seriously fragmented largely due to the loss of or degradation of wetlands in the Central Valley due to an extensive system of dams in the Sierra Nevada Mountains, and dikes and draining for agriculture.

Protected waterfowl habitats in wildlife refuges are an important source of habitat for giant garter snake, but they do not necessarily provide good habitat for this snake when they are flooded in winter and drained in summer. Flooding in winter and draining in summer are opposite of this snake's needs. This snake requires habitat where summer flooding of valley wetlands occurs due to snow melt from the Sierra Nevada Mountains and drying of these areas occurs in winter. Rice fields and irrigation ditches, which are flooded in summer, are now providing good habitat for this snake.

Pesticide and fertilizer runoff from agriculture is also responsible for killing some of this snake's prey, including native red-legged frogs. Grazing of vegetation along water sources also threatens this snake. Introduced watersnakes (*Nerodia* spp.), which occur in the Folsom area, could possibly threaten this snake if they were to spread downriver into the valley.

Life History

The giant garter snake is one of the largest garter snakes, reaching a TL of at least 162 cm (63.7 in.) (58 FR 54053). Once identified as a subspecies of the western terrestrial garter snake, giant garter snake was accorded the status of a separate species in 1987.

Endemic to the valley floor wetlands of the Sacramento and San Joaquin valleys, the snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams and other waterways, and agricultural wetlands. Habitat consists of the following: (1) adequate water during the snake's active season; (2) emergent herbaceous wetland vegetation for escape and foraging habitat; (3) grassy banks and openings in waterside vegetation for basking; and (4) higher elevation upland habitat for cover and refuge from flooding. The giant garter snake feeds on small fish, tadpoles, and frogs (Hansen 1988). They breed in March and April, with females giving birth to live young from late July though early September (Hansen and Hansen 1990).

Although growth rates are variable, young giant garter snakes typically more than double in size by one year of age. The age of sexual maturity averages in males averages three years and averages five years for females (58 FR 54053). Researchers have noticed significant differences in the size of giant garter snakes between different populations. The largest, most robust snakes have been observed in the population newly discovered in 2005 at Yolo Bypass and in the population at Badger Creek in southern Sacramento County (USFWS 2006).

A recent survey report (TNBC 2006) indicated that the size, and thus age distribution and fecundity, of giant garter snakes in the Natomas Basin may be decreasing. The Natomas Basin Conservancy (TNBC) report indicated that the mean size of both female and male giant garter snakes in the Natomas Basin has decreased with time. Furthermore, snakes from the Natomas Basin appear to be smaller than snakes from other populations in the northern area (e.g., Badger Creek and Middle American Basin) (TNBC 2006, Hansen 2003, USFWS 2006). While the TNBC report suggested that the apparent trend of decreasing size, as well as the smaller size, of giant garter snakes in the Natomas Basin could be related to differences in sampling methodology (e.g., hand capture technique versus aquatic sampling, exploratory versus standardized sampling), Eric Hansen (USFWS 2006) suggested these trends may also be attributed to a high rate of mortality and decreased fitness for giant garter snakes in the Natomas Basin that results from nematode infestations and mortality from contact with vehicles. The more recent use of standardized sampling methods should provide additional information as to whether or not a size and age shift is occurring in the Basin.

Distribution At the time of listing, the species was known from the following 13 populations: (1) Butte Basin, (2) Colusa Basin, (3) Sutter Basin, (4) American Basin, (5) Yolo Basin-Willow Slough, (6) Yolo Basin-Liberty Farms, (7) Sacramento Basin, (8) Badger Creek and Willow Creek, (9) Caldoni Marsh, (10) East Stockton-Diverting Canal and Duck Creek, (11) North and South Grasslands, (12) Mendota, and (13) Burrell-Lanare. Each population represented a cluster of discrete locality records. Population clusters 1 through 4 were associated with rice production areas, especially channels and canals that delivered or drained agricultural irrigation water.

These populations were determined to be extant in 1993. Population clusters at Butte, Sutter, and Colusa Basins (1, 2, and 3) were determined to not be imminently threatened with extirpation.

Factors Affecting Giant Garter Snake

At the time of listing in 1993, significant reductions in Central Valley wetland habitat due to land reclamation, agricultural practices and water management (U.S. Department of Interior 1994) had resulted in habitat loss, fragmentation, and isolated habitats throughout the snake's range. Fragmentation continues to be a serious threat to the giant garter snake. Small clusters of giant garter snakes confined to limited habitat areas are likely vulnerable to extirpation from random environmental, genetic, and demographic events (Schonewald-Cox et al. 1983).

The 1993 listing final rule (58 FR 54053) identified the following the threats to giant garter snake habitat: urban development and expansion, particularly near the Sutter basin, American Basin, Badger/Willow Creek, East Stockton and Grasslands populations; USACE flood control projects in Sacramento, Yuba and Sutter counties; and agricultural practices such as canal maintenance and livestock grazing. New information on each of those risks, as well as new risks identified since the time of listing are discussed below:

Urbanization Urbanization is one of the greatest threats to the giant garter snake throughout much of its extant range. Environmental impacts associated with urbanization are loss of habitat, introduction of non-native species with a resulting loss of biodiversity, alteration of natural fire regimes, fragmentation of habitat due to road construction, and degradation of habitat due to pollutants. Within the current range of the giant garter snake, cities that are rapidly expanding and, in some instances, intruding upon or otherwise impacting giant garter snake habitat include, but are not limited to: Chico, Woodland, Yuba City/Marysville, Sacramento, Galt, Stockton, Gustine, Los Banos, Merced, and Fresno. Urbanization increasingly threatens the viability of giant garter snake populations as urban landscapes encroach on ever-diminishing habitat for this listed species. For example, the City of Los Banos, Merced County, experienced a 74.7% increase in population between 1990 and 2000 (U.S. Census Bureau, www.census.gov). This city lies between the northern and southern divisions of the Grasslands Ecological Area (within the Grassland Wetlands) and its growth could affect the giant garter snake populations there (Dickert 2005). California Department of Transportation has proposed rerouting State Route 152 in Merced County. One of the alternative routes would bypass the City of Los Banos to the north, bringing the highway closer to the northern and southern divisions of the Grasslands Ecological Area, impacting the northern division and facilitating further growth in this area (Forrest 2005). The American Farmland Trust projects a loss of more than one million acres of Central Valley farmland to urbanization by the year 2040 if current changes in land use continue (USFWS 2006). This trend implies a loss of rice agriculture and the associated wetlands where giant garter snakes currently occur. Further, viable rice production is subject to influences from encroaching urban and residential development. Potential changes in adjacent land use are likely to occur throughout the region as demonstrated by the burgeoning growth of northern California's population. Rice farmers in the Natomas Basin have indicated that there are difficulties associated with farming rice on land adjacent to urban development because crop dusters can no longer obtain insurance to fly so close to new homes (USFWS 2006).

Since the time of listing, USFWS has issued five section 10(a)(l)(B) permits for projects anticipated to impact the giant garter snake. Three of the five permits are for projects in the Sacramento Valley; the others are for projects located in the San Joaquin Valley. Four of the five permitted projects authorize urban development-related activities. Since the time of listing, USFWS also issued 174 permits that covered the incidental take of giant garter snake. The majority of these permits were for projects that would affect the American Basin and Sacramento area populations.

Flood Control and Canal Maintenance Ongoing maintenance of artificial or natural aquatic habitats for purposes of flood control and agriculture may result in direct mortality to giant garter snakes (Hansen 1988, Brode and Hansen 1992, CDFG 1992, Hansen and Brode 1993). Maintenance activities may also fragment and isolate available habitat, prevent dispersal of giant garter snakes among habitat units, and reduce the availability of cover and giant garter snake prey. Much of the remaining giant garter snake habitat is subject to flood control and canal maintenance activities, subjecting the snake to on-going risks of mortality and injury and the effects of habitat degradation.

Maintenance activities may include weed eradication, which destroys surface cover, and rodent eradication, which indirectly eliminates the occurrence and abundance of underground burrows and retreats for giant garter snakes. Giant garter snakes depend upon rodent burrows to thermoregulate, to provide cover during ecdysis (the shedding of skin), and for over-wintering. The coexistence of burrowing mammals greatly benefits giant garter snakes (Wylie et al. 1996, Wylie et al. 1997). Other types of maintenance activities occurring in irrigation canals include: (1) de-silting, (2) excavation and re-sloping of ditches and channels, (3) deposition of ditch and canal spoils materials on adjacent property, (4) placement of fill material within the canal, and (5) control of vegetation in and around canals, ditches, and drains by moving and other measures. These activities can injure and kill giant garter snakes. A four-year study by Hansen and Brode (1993) monitored newly constructed or modified canals within the Natomas Basin, to determine the rate of establishment of giant garter snake habitat. They observed that ongoing maintenance, including mechanical scraping of canal banks, mowing, and applying herbicides prevented establishment of vegetation in newly relocated canals within the Natomas Basin. Vegetation became reestablished along several smaller canals that were disturbed less frequently. Rodent burrows and crevices suitable for giant garter snake retreats became established sooner where weed eradication was not practiced. Giant garter snake recolonization in relocated canals was not detected during this four-year study. The flood control practice of lining streams and canals with large and extensive quantities of concrete or rock rip rap is detrimental to wetland ecosystems (USFWS 2000). Though giant garter snakes have been observed to use rip rap to thermoregulate, large quantities of rip rap eliminate a natural thermal mosaic, and may be composed of material that degrades and pollutes water. Also, rip rap may be installed in conjunction with ground cloth that is impermeable to rodents thereby preventing rodent burrowing.

Grazing and Agricultural Practices Although no studies have been conducted that specifically examine the potential effects of grazing on the giant garter snake, grazing is a concern for the giant garter snake, particularly in preserves that are managed for this species (USFWS 2006). Grazing can result in the removal of upland refugia and the trampling of aquatic and terrestrial vegetative cover that provide cover and thermal mosaic environment for the snake (USFWS 2006), and giant garter snakes have been observed to avoid areas that are grazed (Hansen 2003). Additional research is needed to better understand the effects of grazing on giant garter snakes.

Wetland Management for Waterfowl Clusters of giant garter snake populations occur on State and Federal refuges managed for wildlife purposes; however, some management actions may not benefit the giant garter snake habitat or its prey base (Dickert 2005, Paquin et al. 2006). Giant garter snakes require water during the active phase of their life cycle in the summer; however, some refuge areas are managed to provide water for waterfowl during the winter and spring months, and are drained during the summer months (Paquin et al. 2006). Summer aquatic habitat is essential because it supports the frogs, tadpoles, and small fish on which the giant garter snake preys. However, permanent water that provides suitable giant garter snake habitat generally supports populations of largemouth bass or other non-native fish that prey upon giant garter snakes.

Introduction and Eradication of Non-Native Plants Introduced, non-native plants may adversely affect the giant garter snake. For example, water primrose (*Ludwigia peploides* ssp. *montevidensis*) may concentrate giant garter snake prey in select pockets. Introduced water primrose has also been observed to constrain movements of giant garter snakes (USFWS 2006), thereby increasing their vulnerability to predation. However, there is a lack of agreement among giant garter snake researchers regarding whether proliferation of the water primrose may adversely affect the species. Some believe that the native water primrose (*Ludwigia peploides* ssp. *peploides*) is a beneficial species that is not as invasive and provides habitat for the snake (USFWS 2006).

Natural Gas Exploration Natural gas exploration on National Wildlife Refuges in both the Sacramento and San Joaquin valleys in 2002 and on privately-owned lands in the Butte Basin in Glenn, Colusa, and Butte Counties in 2003 (USFWS 2002) has likely impacted giant garter snakes. Seismic exploration for natural gas may include the following activities: (1) surveying; (2) drilling; (3) installation of detectors and lines; (4) recording; and (5) equipment removal. Survey work during which the extensive array of detectors and lines are laid out is accomplished primarily on foot. However, four-wheel drive trucks, all-terrain vehicles (ATVs) and a helicopter may also be used. Explosive charges buried in holes are often used as the energy source for recording seismic data at predetermined source points. The giant garter snake can be disturbed by workers walking through their habitat as they conduct surveys, deploy and retrieve source and receiver lines, and remove equipment. Giant garter snake could be disturbed or killed by helicopters deploying drilling equipment in potential snake habitat. Snakes could also be crushed in their burrows by drilling equipment or caused to flee by the wind disturbance from the helicopters (USFWS 2002).

Summary In summary, the primary threats to giant garter snake are loss and degradation of habitat due to urbanization and loss of habitat due to changes in rice production (rice farming provides important giant garter snake habitat). The other threats mentioned above are secondary because they either occur in fewer areas (e.g., oil and gas exploration) or are of lesser magnitude (e.g., grazing) than the loss of habitat to urbanization and the loss of rice production.

Recovery

A draft recovery plan has been produced for the giant garter snake by the USFWS (1999) and it identifies six general action items for recovery of the species:

- Protect existing populations and habitat.
- Restore populations to former habitat.
- Survey to determine species distributions.
- Monitor populations.
- Conduct necessary research, including studies on demographics, population genetics, and habitat use.
- Develop and implement incentive programs, and an outreach and education plan.

In addition, the USFWS has identified the following five recommendations for future actions that address the threats to the giant garter snake and will provide important benefits for the recovery of the species:

- Identify areas of high giant garter snake concentration and corridors of movement to help address the largest threats to the giant garter snake, habitat loss and fragmentation. Emphasize protection and enhancement of habitat and connectivity between concentration areas. Protect additional suitable habitat in each population where available. Habitat to be protected should include corridors between existing populations, between populations and suitable refugia, and suitable habitat adjacent to existing preserves.
- Conduct a focused approach to recovery actions in the San Joaquin Valley, with an integrated effort that includes land use, water management, and water quality issues on private and public lands. Conduct extensive surveys to determine presence/absence, habitat use, and activity of snakes at the southern end of the known range. Conduct additional genetic analysis on southern populations to determine their relatedness to populations in northern and central portions of the species range. These areas likely have very little habitat and may need more active management to maintain any populations there. Increase Partners for Fish and Wildlife efforts on private lands in the southern portion of the species range. Restore and protect suitable habitat for giant garter snakes in San Joaquin Valley (South Valley Recovery Unit in the Draft Recovery Plan). Secure water and suitable water management for San Joaquin Valley giant garter snakes. These actions help address the threats of habitat loss, fragmentation, and degradation that result in the San Joaquin Valley populations continuing to be in danger of extirpation.
- Examine the water quality and toxicology of the giant garter snake's habitat. Conduct a study on whether agricultural pesticides and herbicides and trace elements associated with agricultural runoff (surface and subsurface) pose problems for the giant garter snake.
- Investigate the long-term response of the giant garter snake to mass loss of habitat, in particular from fallowing of rice fields.
- As roads and bridges are constructed or repaired within the range of the giant garter snake, larger and more frequent box culverts should be installed to facilitate giant garter snake movement. For example, when possible, efforts should be made to improve connectivity across I-5 and Highway 99 in the Natomas Basin. Potential connectivity

issues in the Natomas Basin were discussed in the Biological Opinion for the Natomas Basin Habitat Conservation Plan (USFWS File No. 1-1-03-F-0225). The use of larger culverts or free-standing bridges (best) that contain some of the minimum habitat characteristics of the snake (i.e., emergent vegetation up to the culvert entrances, burrows, prey) should provide improved passage opportunities for the snake.

Section 4 Environmental Baseline

The environmental baseline is an analysis of past and ongoing human and natural factors leading to the current status of the species and any critical habitat within the Action Area. The baseline includes State, tribal, local, and private actions already affecting the species or that will occur at the same time as this consultation. Unrelated Federal actions affecting the same species that have completed formal or informal consultation are also part of the environmental baseline, as are Federal and other actions within the action area that may benefit listed species or critical habitat.

The environmental baseline covering a portion of the action area, including the Delta, was described in the 2009 CVP/SWP LTO BiOp (NMFS 2009), and is incorporated here by reference.

4.1 Action Area and Baseline

The Action Area includes terrestrial and aquatic habitat in Contra Costa County, within the Sacramento-San Joaquin Delta. Terrestrial areas include land adjacent to Rock Slough and the constructed Canal. Additionally, facilities and appurtenances to the RSFS are associated with the Action Area, as is the existing Headworks on the Canal. Terrestrial areas included in the Action Area were previously described above. These lands will be maintained in their present, mostly unvegetated state. Additionally, the adjacent levees to the Canal and Rock Slough have graveled surfaces which would be maintained.

The Headworks on the Canal historically provided a minimal barrier to fish species entering the Canal and traveling to PP1. PP1 is a passage barrier to fish utilizing the Canal. The Canal is primarily earthen lined, except for a recent enclosure of approximately 1,000 feet, near Marsh Slough. Plans for further enclosure of the Canal, completed under separate environmental review, are being developed and have received partial funding.

Habitat in the Canal for listed fish species has historically been poor. The waterway has been populated primarily by non-native fishes and it supports a relatively a high population of predatory fish, including striped bass, largemouth bass, and various sunfish species. Monitoring of the Canal at the Headworks and PP1 has been required for many years. Since 1998, approximately 35 listed salmon and steelhead, zero green sturgeon, and one delta smelt have been captured during regular monitoring.

The Canal has limited cover and the aquatic vegetation present include algae, Brazilian elodea, water hyacinth, cattails, and tules. The Canal was historically treated with herbicides to reduce aquatic vegetation which adversely affected water quality and the ability to operate PP1. Informal consultations with USFWS and NMFS have been completed for control of aquatic vegetation in the Canal. A variety of herbicides have been used, including copper based products, as a consequence the habitat is poor for listed fish species.

Rock Slough connects to Old River and the wider expanse of the Delta. Water can flow one way from Rock Slough to Sand Mound Slough via a one-way regulated water control structure. During incoming tides, flow from Rock Slough to Sand Mound Slough may occur. Additionally, during incoming tides, flow from Rock Slough historically entered the Canal. With operation of PP1, flows of water also were drawn into the Canal from Rock Slough.

Although CDBW and other entities treat the Canal with herbicide, Rock Slough does not receive these treatments. Herbicide loading in Rock Slough occurs primarily from secondary sources and drift, instead of direct application. The quality of habitat in Rock Slough is limited; however, based upon monitoring conducted at the Headworks conditions in the Canal are poorer.

The land use in the vicinity of the Canal and Rock Slough includes agricultural and urban lands, with the latter becoming more prominent with recent developments near the Canal. Agricultural use includes pasture land and some field cropping.

Section 5 Effects of the Action

This section contains four subsections regarding the potential effects of the Project to the seven species described in Section 3.0. Section 5.1 provides background information concerning existing and proposed incidental take coverage and provides recent documentation of listed species in the vicinity of the Project Area. Section 5.2 discusses the direct and indirect effects of the Project for each Project component. Section 5.3 discusses the effects to the seven listed species and Section 5.4 provides a discussion of cumulative effects.

5.1 Background

Data gathered from sorting through the debris collected by the rakes demonstrates that fish are removed along with the debris. In 2013, the majority of the debris removed by the rakes was sorted and 193 fish comprised of 10 species were found in the debris piles. The overwhelming majority (99%) of these fish were non-native species; the only native species found in the debris in 2013 were prickly sculpin *Cottus asper* (n=1) and Pacific lamprey *Lampetra tridentata* (n=1). However, in 2011, 2012, and 2015, fall-run Chinook salmon were found in the debris removed by the screens and in 2012 a steelhead was found in the debris removed by the screens.

Besides fish, the Project may affect other ESA listed species. Surveys were conducted for federally threatened giant garter snake during construction of the RSFS and during mechanical harvesting of aquatic weeds in 2015 and 2016. Although giant garter snake was not observed and has never been observed in the vicinity of the RSFS Facility, the lack of detection does not guarantee that the snake is not present since it is very reclusive and suitable habitat exists within the Project area.

For these reasons, Reclamation is requesting incidental take coverage for the Project, including the incidental take that may occur as a result of improvements or modifications to the RSFS and their testing, and with O&M activities of the existing and modified facilities. Reclamation is particularly concerned with the risk of potential take of protected species that may be associated with the rake mechanism and other screen appurtenances and during maintenance. Reclamation is requesting the following annual incidental take coverage (includes both adults and juveniles) for the Rock Slough Project:

- 10 spring-run Chinook salmon
- 5 winter-run Chinook salmon
- 5 Central Valley steelhead
- 2 green sturgeon
- 2 delta smelt
- 2 longfin smelt
- 2 giant garter snake

Existing incidental take coverage of CCWD's other facilities and operations is not included as part of the consultation for this Project.

5.2 Effects Assessed

Direct and indirect effects of the Project are discussed for the following:

- Improvement of the RSFS.
- Ongoing O&M of the existing and/or modified rakes designed to keep the RSFS clean.
- Ongoing O&M activities in the vicinity of the RSFS.
- Irrigation system improvements and land area encroachment repairs.
- Actions associated with Reclamation's potential land acquisition and/or land use authorizations.

Detailed descriptions of Project components listed above are provided in Section 2.2 and the Action Area is defined in Section 2.3.

5.2.1 Effects from Making Improvements/Repairs to the RSFS Facility

The direct and indirect effects of making improvements/repairs to the RSFS Facility are examined below. CCWD will implement the measures listed in Section 2.4 appropriate to the action being taken to reduce the likelihood of effects to listed species.

Rake Improvements

There will be no adverse effects to listed fish species from making the improvements to the RSFS rake system because no in-water work will be conducted.

Direct effects of making the improvements to the RSFS rake system may include mortality of or injury to giant garter snake from vehicle or equipment strikes during access to the work area.

Indirect effects to giant garter snake may include latent mortality if the snakes were injured from contact with heavy equipment or vehicles accessing the construction areas. Physical injury may cause stress that might contribute to greater risk of predation or chance of infection. However, noise from vehicles and equipment may cause giant garter snake to avoid or vacate the area during construction activities, and therefore latent mortality is less likely to occur.

Some of the direct and indirect effects to listed fish species and giant garter snake from rake improvements are beneficial. Improving the rakes will result in more efficient debris removal that will benefit listed species by:

- Removing debris more efficiently, which will ensure that approach velocities at the agency-required 0.2 fps are maintained, and therefore reduce entrainment and impingement.
- Reducing aquatic weeds offshore of the screen will reduce the likelihood that listed species will become entangled in the weeds and be susceptible to entrapment and removal from Rock Slough.

- Reducing the aquatic weeds offshore of the screen will remove cover for predatory fishes that can feed on or injure listed aquatic species.
- Installing the new hydraulic seal containment/cooling/alarm system will decrease the possibility of hydraulic fluid entering Rock Slough.
- Re-programming of the rake head, which will provide multiple cleaning modes, that will improve cleaning and enable various debris removal and brush-only cycles that will reduce entrainment, impingement, and entrapment.

Although the re-designed rake heads will be more effective at capturing and removing debris, their use may potentially result in take of listed fish species and giant garter snake during operation. The effects of operating the improved rakes are discussed further in Section 5.2.2.

Debris Conveyance System Improvements

There would be no direct and indirect effects to listed fish species and giant garter snake from modifying the debris pits. Therefore, debris conveyance system improvements (modification of the debris pits) will not affect listed fish species and giant garter snake.

Platform Extension

The platform extensions will be fabricated off-site and installed at the RSFS. The platform will be constructed without any in-water work within Rock Slough. Direct effects of extending the platforms include the following:

- Mortality of or injury to giant garter snake from vehicle or equipment strikes during access to the work area.
- Mortality of or injury to giant garter snake and listed fish species resulting from the minor shading by the extensions that may increase the attractiveness of the habitat and increase the risk of predation or capture by the rakes.

Boat Ramp Construction

The boat ramps were carefully designed to use precast interlocking reinforced concrete that allows for settling and requires no concrete casting in or near the water. Direct effects of constructing the boat ramps may include the following:

- Mortality of or injury to giant garter snake and listed fish species during installation of the silt curtains, excavation of the ramp areas, placement and compaction of drain rock, and installation of the precast interlocking reinforced concrete pads.
- Mortality of or injury to listed fish species and giant garter snake from increased turbidity during construction.
- Reduction in prey of listed fish species from permanent loss of benthic habitat.

Mortality of or injury to listed fish species and giant garter snake could occur during installation of the silt curtains, in-water excavation, placement and compaction of drain rock, and in-water installation of the precast interlocking reinforced concrete pads if these species are present during construction activities and do not move away from the affected area.

A small area of benthic habitat will be permanently removed in Rock Slough (~0.02 acre) and in the afterbay of the RSFS (~0.02 acre) as a result of the construction of the boat ramps. This benthic habitat could contain amphipods, annelid worms, and various life stages of insects, clams, snails, etc., all of which can provide food for listed fish species. The area of the boat ramp behind the screen is not accessible to any life stages of listed fish species other than larval and post-larval delta and longfin smelts, and therefore the boat ramp behind the screen will not bury foraging habitat for listed fish species other than for the early life stages of smelts. Incidental take of entrained delta smelt at the Rock Slough intake was previously covered by the following two USFWS BiOps: the 1993 Los Vaqueros BiOp for delta smelt and the 2008 CVP/SWP LTO BiOp.

The boat ramp in Rock Slough is located in designated critical habitat for delta smelt, although the habitat is not ideal due to the presence of invasive aquatic weeds that lowers turbidity, slows the movement of water that could result in higher water temperatures, and provides habitat favoring predatory and non-native species (see Table 13). Therefore, permanent loss of this small amount of benthic habitat in Rock Slough is insignificant and is not likely to adversely affect listed fish species by reduction of prey items or giant garter snake as they consume frogs, tadpoles, and small fish. This loss of benthic habitat is minor and would be insignificant as there is ample suitable habitat immediately surrounding the boat ramp areas.

The Project has already mitigated for habitat and wetland losses by purchasing 0.3 acre at Kimball Island Mitigation Bank and 30.5 acres at the Big Break shoreline. Reclamation and CCWD considered installing boat ramps in front and behind the screen when these areas were dewatered in 2011 but funding was not sufficient at that time. For the 2009 RSFS Project the September 2009 USFWS concurrence letter (81420-2009-I-1015-1) included the following:

> *Wetland impacts are estimated to be less than one acre of permanent impacts and less than eight acres of temporary impacts. Aquatic habitats permanently affected include seasonal wetlands within irrigated pasture, open waters of Rock Slough, and drainage ditches. All temporary wetland impacts will be restored within one year. Construction of the project requires widening of the canal entrance and results in an increase of approximately 0.89 acres of open water downstream of the fish screen. The currently proposed wetland impacts are a reduction from the 1999 impact assessment of 6.8 of permanent and 15.2 acres of temporary impacts. In 1999, Reclamation obtained more than 30 acres of offsite mitigation to compensate for permanent wetland impacts to support the Corps permit. In addition, to mitigate for these wetland impacts, Reclamation acquired 30.5 acres of wetlands on a portion of the Old Lauritzen Property near Big Break and acquired 0.30 acres of Shallow Water Habitat credits at the Kimball Island Mitigation Bank.*

CCWD further obtained 36 acres of aquatic species habitat mitigation credits at the Liberty Island Mitigation Bank under its California ESA (CESA) Incidental Take Permit No. 2081-2008-013-03. The CESA take permit covered potential take of winter and spring-run Chinook salmon, delta smelt, and longfin smelt. The Liberty Island Mitigation Bank also covered impacts to steelhead, which are not a state-listed species. The 36 acres of mitigation was intended to address all of CCWD's intakes and assumed that Rock Slough was unscreened. Aquatic species impacts are now less given that the RSFS has been constructed.

The indirect effects to listed fish species and giant garter snake could result from latent mortality due to injury during construction activities. Physical injury may cause stress that might contribute to greater risk of predation or chance of infection. However, injury is less likely to occur because noise and vibration during construction activities may cause listed species to move away and avoid being injured.

Log Boom Placement and Maintenance

Direct effects of placement and maintenance of the log boom may include the following:

- Mortality of or injury to giant garter snake during installation of the permanent anchoring system due to interaction with construction vehicles and from the potential burying of snakes during anchor placement.
- Mortality of or injury to listed fish species and giant garter snake could also occur from boat propeller strikes during placement and maintenance of the log boom. Boat noise, motor vibration, and disturbance of the water may cause listed fish species and giant garter snake to avoid or vacate the area.

The indirect effects to listed fish species and giant garter snake could result from latent mortality due to injury if these species were struck by a boat propeller and died later from their injuries. Physical injury may cause stress that might contribute to greater risk of predation or chance of infection. As previously stated, boat noise, motor vibration, and disturbance of the water may cause listed fish species and giant garter snake to avoid or vacate the area during placement, and therefore, latent mortality from boat strikes is unlikely to occur.

There are many benefits to listed fish species and giant garter snake from relocating the log boom. The log boom will help to control the floating invasive aquatic weeds that choke the area offshore of the RSFS. Limiting the floating vegetation offshore of the RFSF will reduce the amount of herbicide that needs to be applied and will reduce the size of the area requiring treatment. The aquatic habitat will benefit as a result of controlling the invasive aquatic weeds by increasing turbidity, increasing DO levels, removing shading effects caused by plants covering the water's surface, possibly increasing the movement of water that could result in lower water temperatures during certain times of the year, and providing habitat that favors native fish. Giant garter snake will also benefit from improving the habitat for its aquatic prey species such as fish and amphibians. Finally, both listed fish species and giant garter snake will benefit from restricting the area downstream of the log boom to recreational boaters that could inadvertently strike these species with propellers or catch listed fish while fishing.

Irrigation System Improvements

Direct effects of pump replacement to giant garter snake and listed fish species may include the following:

- Mortality or injury during placement of the pumps in the stilling wells.
- Mortality or injury from boat propeller strikes.

It is unlikely that giant garter snake or listed fish species would be affected during placement of the pumps in the stilling wells as they do not provide habitat for listed species. Because this activity takes place in the afterbay of the RSFS, no listed fish species are expected to be in the area, other than larval delta and longfin smelts. Take for these species/life stages has been previously covered. Noise and vibration by the boat used for these improvements are anticipated to result in movement of giant garter snake away from the work area. Operating the boat at slow speeds will also reduce the likelihood of contact with giant garter snake.

The indirect effects of pump replacement to giant garter snake may include latent mortality if this species were struck by a boat propeller and died later from their injuries. Physical injury may cause stress that might contribute to greater risk of predation or chance of infection. As previously stated, boat noise, motor vibration, and disturbance of the water may cause giant garter snake to avoid or vacate the area during deployment, and therefore, latent mortality from boat strikes is unlikely to occur.

There will be no direct or indirect effect of replacing the valves to listed fish species because this work occurs on land. Therefore, valve replacement(s) will not affect listed fish species.

Direct effects of valve replacement to giant garter snake may include the following:

- Mortality or injury from vehicle or equipment strikes.
- Removal or burial of giant garter snake during excavation.

Indirect effects of valve replacement to giant garter snake could include latent mortality. If injured, giant garter snake could be susceptible to infection and predation.

Direct effects of freshwater irrigation intake improvements (screen cleaning) to giant garter snake and listed fish species may include the following:

- Mortality or injury from boat propeller strikes.
- Mortality or injury from temporary increases in turbidity.

It is unlikely that giant garter snake would be affected during freshwater intake screen cleaning. Because this activity takes place in the afterbay of the RSFS, no listed fish species are expected to be in the area, other than larval delta and longfin smelts. Take for these species/life stages has been previously covered. Boat noise and vibration during these improvements is anticipated to result in movement of giant garter snake away from the work area. The increase in turbidity, under the scenarios of either cleaning by hand or the airburst system, will be short term and temporary and ambient conditions are anticipated to return shortly after the screen is cleaned. If the floating raft system is used, cleaning would be done on land, and therefore there would be no increase in turbidity.

The indirect effects of freshwater irrigation system cleaning to giant garter snake could include latent mortality. If injured, giant garter snake could be susceptible to infection and predation.

Land Area Encroachment Repairs

Direct effects to giant garter snake and listed fish species from conducting land encroachment repairs may include the following:

- Mortality of or injury to giant garter snake from vehicle or equipment strikes.
- Mortality of or injury to listed fish species and giant garter snake during installation of the coffer dam and culvert in the Rock Slough Extension.
- Mortality of or injury to listed fish species and giant garter snake from increased turbidity within the Rock Slough Extension.
- Removal or burial of giant garter snake during excavation, grading, re-seeding, and restoration.
- Temporary disturbance of giant garter snake and its prey.

Indirect effects to listed fish species and giant garter snake from conducting land encroachment repairs may include the following:

- Latent mortality of giant garter snake subjected to injury from contact with heavy equipment or during fence installation, grading, reseeding, filling, or reconstructing.
- Latent mortality of listed fish species from injury during culvert replacement work.

Latent mortality of listed fish species and giant garter snake could occur as a result of land area encroachment repairs. If giant garter snakes are injured by vehicles, equipment, or during grading, they could die of their injuries. The risk of latent mortality is reduced because the majority of the work will occur during the snake's active period. Also, in the unlikely event that giant garter snakes are present, noise and vibration may cause them to leave the work area and thereby avoid injury. Listed fish, if injured during culvert work, could die as a result of injury. However, the risk of latent mortality is low because the work will occur when listed fish species are unlikely to be in the area. Physical injury may cause stress that might contribute to greater risk of predation or chance of infection. However, noise from vehicles and equipment may cause giant garter snake and listed fish species to avoid the area during land encroachment repair activities, and therefore latent mortality is less likely to occur.

Site Access

Direct effects to giant garter snake and listed fish species from equipment and trucks accessing the construction areas may include the following:

- Mortality or injury from equipment or vehicles striking giant garter snake during access to the construction/maintenance sites.
- Temporary disturbance to giant garter snake prey species.
- Vibration and noise from heavy equipment and vehicles causing giant garter snake to leave the affected areas.
- Increased turbidity in the Canal and Rock Slough as a result of dust from the gravel access road making it more difficult for giant garter snake (a visual ambush predator) and listed fish species to catch aquatic prey.

Indirect effects to giant garter snake from trucks and heavy equipment accessing the construction areas may include latent mortality. Physical injury may cause stress that might contribute to greater risk of predation or chance of infection. However, noise from vehicles and equipment may cause giant garter snake to avoid or vacate the area during access to construction sites, and therefore latent mortality is less likely to occur.

Staging Areas & Parking

Direct effects to listed fish species and giant garter snake from staging and parking areas may include the following:

- Mortality of or injury to listed fish species and giant garter snake from materials, fuels, lubricants, and solvents draining, spilling, or seeping into Rock Slough.
- Mortality of or injury to giant garter snake from equipment or vehicle strikes.
- Temporary disturbance of giant garter snake and its prey.

Listed fish species and giant garter snake could be affected by activities occurring in staging and parking areas. Construction materials, trash, and spilled lubricants, solvents, or fuels have the potential to enter into Rock Slough and the Canal from staging and parking areas. Depending on the toxicity of the substance, there could be mortality or injury to listed fish species and giant garter snake.

Giant garter snake could be struck by vehicles and heavy equipment, and giant garter snake and their prey could be temporarily disturbed. The likelihood of vehicle and equipment strikes is low because vibration and noise from the equipment would likely cause giant garter snake to move away from the area.

Indirect effects to listed fish species and giant garter snake from the staging and parking areas may include the following:

- Latent mortality of listed fish species and giant garter snake from materials, fuels, lubricants, and solvents draining, spilling, or seeping into Rock Slough.
- Latent mortality of giant garter snake from vehicles or equipment.

Physical injury from toxic substances entering Rock Slough or the Canal may cause stress that might contribute to greater risk of predation or chance of infection. Lower reproduction also may result from exposure to toxins.

5.2.2 Effects from Ongoing Operation of the RSFS Rakes

The direct and indirect effects of making improvements/repairs to the RSFS Facility are examined below. CCWD will implement the measures listed in Section 2.4 appropriate to the action being taken to reduce the likelihood of effects to listed species.

Rake Operations

Direct effects to listed fish species and giant garter snake from ongoing operation of the RSFS, including the modified rakes, may include the following:

- Mortality from being entrapped in the rake buckets and subsequently removed from Rock Slough.
- Mortality or injury from contact with the rake buckets.
- Mortality or injury from accidental releases of hydraulic fluid.
- Temporary disturbance to listed fish species, giant garter snake, and their prey.

Increased noise and disturbance of the water during operation of the rakes may cause listed fish species, giant garter snake, and their prey to temporarily avoid the area. The effect of increased noise and disturbance of the water may help to prevent listed species from contacting the rake.

Indirect effects to listed fish species and giant garter snake from ongoing operation of the RSFS rakes may include latent mortality. Latent mortality of listed fish species and giant garter snake could result if these species are injured by the rakes or by accidental releases of hydraulic fluid. Utilizing the measures described above reduces the likelihood of injury. Although it's presumed that take would be similar to, or less, for iteratively modified rakes, the changes that are made to enhance rake performance against weeds may affect take of giant garter snake or listed fish species to a greater or lesser degree; a priori, determining that effect is not estimable.

Debris Management and Monitoring

There will be no negative direct effects from debris management to listed fish species. CCWD uses routine fish monitoring data along with observations of both the intake forebay and the debris to determine if listed fish species are present. If salmonids are present at the RSFS, debris will be monitored more frequently.

Direct effects to giant garter snake from debris management may include mortality or injury from being struck by vehicles transporting debris or by being buried by debris when it is offloaded or spread. The likelihood of direct effects to giant garter snake from debris management is low as the area containing the debris pits and the drying area is paved, and therefore does not provide habitat for giant garter snake.

Indirect effects to giant garter snake from debris management may include latent mortality from being struck by vehicles transporting debris or being buried by debris when it is offloaded. The likelihood of latent mortality is low.

5.2.3 Effects from O&M Activities

Table 23 is a subset of expected maintenance activities at the RSFS that are covered by the 2005 USFWS BiOp. The actual maintenance activities may vary and differ from the list but will be limited by the 41 proposed maintenance activities within the 2005 USFWS BiOp and that are proposed for the RSFS. Measures for each of these specific activities are included below.

Table 23 Maintenance activities that most commonly occur within the Project area and the likelihood of affecting listed species

Maintenance Activity/ Reference from USFWS 2005 BiOp	Location (Water and/or Land)	Duration & Frequency	Season/Timing of Activity	Species Potentially Affected	Likelihood of Affecting Listed Fish and Giant Garter Snake	Incidental Take Coverage Required
In-water inspection/#32	In front of and behind RSFS (water)	Once or twice per year	Late winter, early spring	Listed fish and giant garter snake	Very low	Yes
Log boom maintenance/#36	Area in front of RSFS (water and land)	As required, anticipate 1 to 2 times per year	Anytime	Listed fish and giant garter snake	Very low	Yes
Application of coatings/#49, netting, or spikes	RSFS Structure, REFSF buildings and equipment (over water and land)	As required	Spring through fall during warm weather	None	Low	No
Installation of fenceposts, and trenching /#23	RSFSF (land area and deck)	As required	Anytime	Giant garter snake	Low	Yes, only for giant garter snake
Aquatic weed contact herbicide application (spraying)/#1	In front of and behind the screened facility (water)	One week to complete activity each occurrence, will include spot treatments at regular time intervals	June through October	Listed fish and giant garter snake	Low to medium, and if necessary, monitoring	Yes
Mechanical removal of aquatic weeds/#13	In front of and behind the screened facility (water)	Up to two weeks to complete activity each occurrence, expected to be used for larger vegetation removal efforts	June through October	Listed fish and giant garter snake	Low to medium with biological monitoring	Yes
Pressure wash fish screens and bridges/#24, #50	On bridge deck (over water)	As needed, but anticipated not more than twice per year	As needed	Listed fish and giant garter snake	Low	Yes, for giant garter snake and listed fish

Maintenance Activity/ Reference from USFWS 2005 BiOp	Location (Water and/or Land)	Duration & Frequency	Season/Timing of Activity	Species Potentially Affected	Likelihood of Affecting Listed Fish and Giant Garter Snake	Incidental Take Coverage Required
Silt removal/#53	In front of and behind the RSFS (water).	As needed, but anticipated once per five (5) years.	Jul–Oct	Listed fish and giant garter snake	Low	Yes
Discing/ mowing rights-of-way/ contact terrestrial and pre-emergent herbicides, hand and mechanical control of terrestrial vegetation, removal of trash/#2, #3, #8, #13, #16, #19, #40, #41	Within ROW, unpaved areas (land)	Three weeks to complete discing and mowing each occurrence; up to two occurrences per year. As needed for other activities	Mar–Oct for discing and mowing	Giant garter snake	Low, with biological survey	Yes, only for giant garter snake
Mechanical rake maintenance including rake head, wire ropes, and hydraulic and debris handling systems/#25, #58	RSFS (deck and over water)	As needed but anticipated one to two times per year.	Any time of the year	Listed fish and giant garter snake	Low	Yes
Squirrel baiting/#22	In ROW, on levees, embankments, around buildings (land)	As needed	As needed	Giant garter snake	Low	Yes, only for giant garter snake

The 41 O&M activities are discussed individually below. These O&M activities are numbered as they were in the USFWS 2005 BiOp, and therefore, are not numbered sequentially.

1. Aquatic Weed Contact Herbicide Application.

Aquatic herbicide application may have direct and indirect effects to listed fish species and giant garter snake. Proposed herbicides, their typical application period, application rates, and toxicity data for various taxa are summarized for the CCWD aquatic herbicide program (Table 24).

Table 24 Summary of the aquatic herbicide program proposed for use by CCWD

Brand Name	Justification for Use	Application Period	Application Rate	Toxicity Data
Clearcast®	Consider use if weeds offshore of the RSFS exceed the rated capacity of the rakes to lift weeds out of Rock Slough, if weeds cause a differential at the screen, and if weeds prevent observation of the offshore area of RSFS.	June – October	Water hyacinth: 16-32 fl oz/acre 50-200 ppb Water primrose: 32-64 fl oz/acre 50-200 ppb Coontail: 200-500 ppb *Brazilian elodea*: 200-500 ppb	***Fish*** Bluegill: 96-hr LC50 >119 mg/L; >119,000 ppb Rainbow trout: 96-hour LC50 >122 mg/L=122,000 ppb
Roundup Custom™	Consider use if weeds offshore of the RSFS exceed the rated capacity of the rakes to lift weeds out of Rock Slough, if weeds cause a differential at the screen, and if weeds prevent observation of the offshore area of RSFS.	June–October	For water hyacinth and water primrose Ground broadcast: 3-7.5 pints/acre (upper end for high density) Handheld: 1.5% solution by volume for spray-to-wet, 4-8% for low-volume directed spray	***Fish*** Rainbow trout: Acute, 96-hr, static, LC50: >1000 mg/L ***Invertebrates (Crustacean)*** Daphnia: Acute, 48-hr, static, EC50: 930 mg/L
GreenClean® Liquid 2.0	Must use if filamentous algae is causing a differential at the screen to avoid damaging the screen panels and the structure.	June–October	Water application either by spot treatment (applied directly over infested area), liquid (solution sprayed from shore or boat), or injection (solution injected into water via a piping system) Filamentous algae: 2.4-24.0 gal/AF or 0.5-5 ppm depending on algal growth/density	***Fish*** Rainbow trout: 48-hr, LC50 - >40 mg/L; > 40 ppm ***Arthropod*** Highly toxic to bees ***Crustacean (Invertebrate)*** EC50, 48-hr; 126.8 mg/L

Brand Name	Justification for Use	Application Period	Application Rate	Toxicity Data
Phycomycin® SCP	Must use if filamentous algae is causing a differential at the screen to avoid damaging the screen panels and the structure.	June–October	Filamentous algae: 3-100 lb/AF 0.3-10.2 ppm	***Fish*** Bluegill: 96-hr LC50 320 mg/L; 320 ppm Fathead minnow 96-hr LC50 70.7 mg/l; 71 ppm ***Invertebrates (Crustacean)*** Daphnia: 48-hr LC50 265 mg/L; 265 ppm

Notes: LD50/LC50 is the amount of an ingested substance that kills 50% of a test sample. EC50 is the concentration of a toxicant at which 50% of its maximum response is observed.

Direct effects of herbicide application could include mortality to listed fish species and giant garter snake if the species were struck by the propeller of the boat. The likelihood of propeller strikes is low because water disturbance and noise from the boat engine would likely cause listed fish species and giant garter snake to move away from the area. Additionally, the boat will travel at low speed (generally below 5 mph) while applying herbicides, which should give ample time for wildlife to leave the area.

Listed fish species in Rock Slough could be adversely affected by the application of herbicides if the effective concentration of an herbicide exceeds a species' toxicity tolerance. The reported toxicity tolerances of surrogate taxa were compared with the required effective concentration of each herbicide needed to treat its intended target plant species. The concentrations required of Clearcast®, GreenClean ® Liquid 2.0, Phycomycin® SCP, and Roundup Custom™, according to their labels, all fall well below the reported toxicity tolerances of bluegill and rainbow trout[10]. Clearcast®'s toxicity to bluegill (96-hr LC50) is above 119,000 ppb and is 122,000 ppb for rainbow trout; the concentration needed to control Brazilian elodea (the highest concentration required) is 200–500 ppb, well below what is considered toxic to bluegill and rainbow trout. The concentration of GreenClean® Liquid 2.0 needed to treat filamentous algae is 0.5–5 ppm; it is toxic to rainbow trout (48-hr LC50) at levels greater than 40 ppm (GreenClean ®Liquid 2.0 MSDS). Phycomycin® SCP is toxic to bluegill (96-hr LC50), fathead minnow, and daphnia (an invertebrate; Crustacean) (48-hr LC50) at 320 ppm, 70.7 ppm, and 265 ppm, respectively. The concentration of Phycomycin® SCP required to control filamentous algae is 0.3–10.2 ppm

[10] No specific toxicity data exist for listed species found in the vicinity of the RSFS, so data for surrogate taxa are used. Toxicity tolerance of listed species may be less than what is reported for surrogate taxa; sublethal effects may also occur from application of these aquatic herbicides.

(Phycomycin® SCP MSDS). The label for Roundup Custom™ does not list application concentrations in ppm or ppb, however the MSDS states that this product is practically non-toxic to fish and invertebrates, with a 96-hr LC50 to rainbow trout of greater than 1,000 ppm and a 48-hr EC50 to daphnia of 930 ppm (Roundup Custom™ MSDS). If these herbicides proposed for use by CCWD are applied according to the concentrations specified on the labels, Clearcast®, GreenClean® Liquid 2.0, Phycomycin® SCP, and Roundup Custom™ are not likely not to cause direct mortality to the species tested.

All herbicides proposed for use would be expected to have relatively low toxicity to surrogate taxa if applied at labeled rates. Toxicity of most of these herbicides to most listed fish species is unknown. Smelts, because of their small size and delicate nature, may be more susceptible to effects of the herbicides than the surrogate taxa tested. Only trained personnel will conduct herbicide application, and all personnel are required to follow precautionary measures to prevent spills, therefore spills are unlikely to occur. All personnel are familiar with the application rates, and therefore, it is unlikely that the specified rates of application would be exceeded.

The potential for effects to listed fish species are reduced somewhat because the herbicides would be applied to dense populations of vegetation, and these areas do not provide high quality habitat for listed fish species. The densities of listed fish species in areas where herbicide applications would occur is expected to be low due to the relatively poor habitat. Waters in Rock Slough are relatively slow flowing and it is a “dead end” waterway near the RSFS, which can potentially reduce attraction of fish to the area, but also increases the residency time for materials that are applied.

Giant garter snake in Rock Slough could be adversely affected by the application of herbicides if the effective concentration of an herbicide exceeds the species’ toxicity tolerance. No specific toxicity thresholds for the herbicides proposed for use were available for giant garter snake, or reptiles in general. The potential for effects to giant garter snake is reduced somewhat because the herbicides would be applied to dense populations of vegetation, and these areas generally do not provide high quality habitat for giant garter snake. Additionally, giant garter snake does not spend all of its life within water and much time spent is in terrestrial habitats that would not be subject to aquatic herbicide application. Rock Slough is also only marginally appropriate habitat for giant garter snake as it has very little bulrush or cattail vegetation on its banks, is not near rice fields (an important habitat for giant garter snake), and contains large predatory fish, so the likelihood of this species being present at any given time is low.

CCWD shall adhere to the avoidance measures in Section 2.4.3 to limit the extent of direct effects to listed fish species and giant garter snake from herbicide application.

Indirect effects of herbicide application include:

- Latent mortality of listed fish species and giant garter snake from propeller strikes and herbicide exposure.
- Reduction of listed fish and giant garter snake prey species.
- Reduction in DO concentrations resulting from the decomposition of vegetation following herbicide application.

Latent mortality of listed fish species and giant garter snake could occur if these species were struck by a boat propeller and died later from their injuries. Physical injury may cause stress that might contribute to greater risk for predation or chance of infection. As previously stated, boat noise, motor vibration, and disturbance of the water may cause listed fish species and giant garter snake to avoid or vacate the area during herbicide application, and therefore injury followed by latent mortality from boat strikes is unlikely to occur.

Invertebrates in Rock Slough could be adversely affected by the application of herbicides if the effective concentration of an herbicide exceeds a species' toxicity tolerance. Invertebrate mortality would have an indirect effect on listed fish species by reducing the amount of prey items available for consumption. According to the labels of Clearcast®, GreenClean ® Liquid 2.0, Phycomycin® SCP, and Roundup Custom™, the concentrations required to control their intended target plant species fall below the levels considered toxic to the invertebrates tested. Clearcast®'s toxicity to the crustaceans tested (48-hr EC50) is 126,800 ppb; the concentration needed to control Brazilian elodea (the highest concentration required) is 200–500 ppb, well below what is considered toxic to crustaceans. The concentration of GreenClean® Liquid 2.0 needed to treat filamentous algae is 0.5–5 ppm; it is toxic to crustaceans (taxon not specified) (48-hr EC50) at 128 ppm (GreenClean® Liquid 2.0 MSDS). Phycomycin® SCP is toxic to daphnia (48-hr LC50) at 265 ppm. The concentration of Phycomycin® SCP required to control filamentous algae is 0.3–10.2 ppm (Phycomycin® SCP MSDS). The label for Roundup Custom™ does not list application concentrations in ppm or ppb, however the MSDS states that is practically non-toxic to the invertebrates tested, with a 48-hr EC50 to daphnia of 930 ppm (Roundup Custom™ MSDS). If these proposed herbicides are applied according to the concentrations specified on the labels, Clearcast®, GreenClean® Liquid 2.0, Phycomycin® SCP, nor Roundup Custom™ will likely not cause mortality to the invertebrates tested.

The rapid decay of vegetative material after herbicide application could reduce DO within Rock Slough. Low DO levels may result in fish and aquatic invertebrate kills and can interfere with salmonid migration[11] (USDA and CDBW 2012). Fish begin to experience oxygen stress and exhibit avoidance at levels below 5 ppm. Toft (2000, as cited in USDA and CDBW 2012) states that DO levels under water hyacinth canopies are already low, finding DO levels below 5 ppm under hyacinth beds. Removal of water hyacinth should ultimately result in increased DO levels. Low DO levels may temporarily deplete the abundance of fish, which are a primary prey species for giant garter snake. However, the effects to giant garter snake will likely be minimal as they have other prey species (e.g., adult frogs) which are not likely to be affected by low DO levels. The extent of the area of potential indirect effects beyond the area of herbicide application is difficult to determine. Hydrological and environmental data for each herbicide are not available for the specific environment around the Project. Because the herbicides selected by CCWD are relatively non-toxic to surrogate fish and invertebrate taxa, it is assumed that the area of direct and indirect effects is similar to the area of application (Figure 28).

[11] Rock Slough is a dead-end slough and is not a migratory corridor for salmonids.

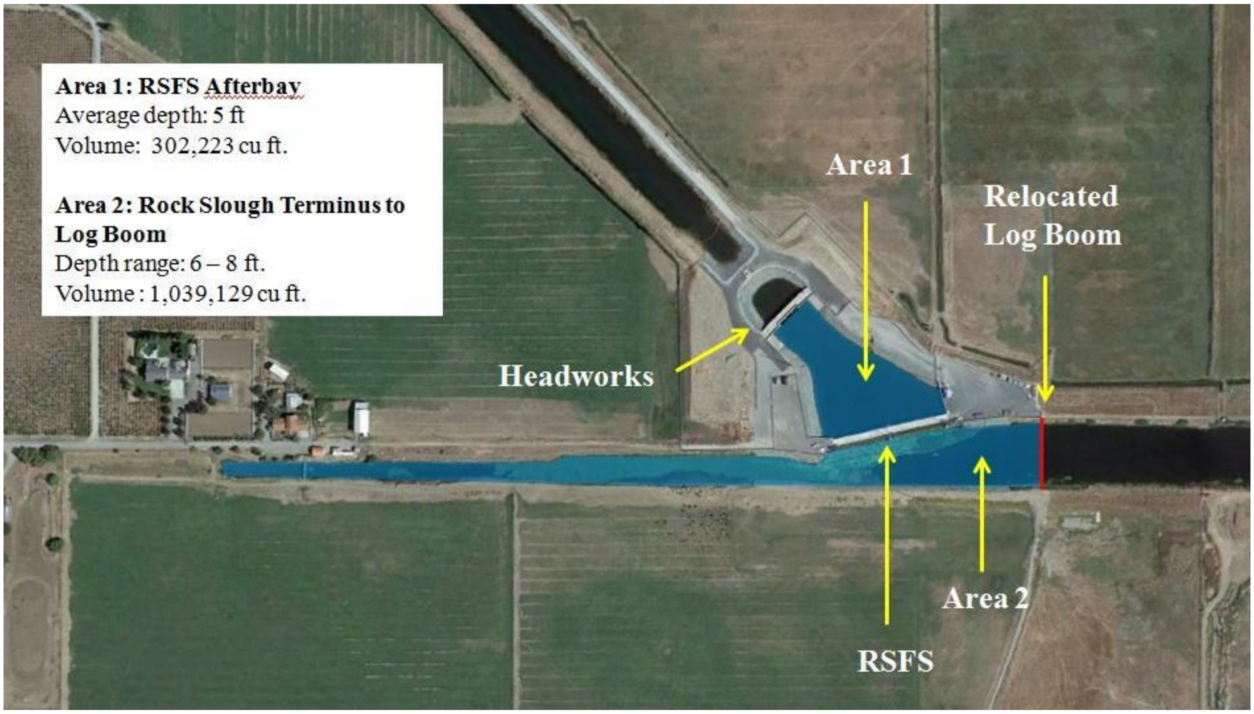

Figure 28 Area of herbicide application for the RSFS Improvement Project

Adhering to the measures for direct effects listed in Section 2.4.3 will also limit the indirect effects of herbicides on listed fish species and giant garter snake. In addition, a silt curtain would be deployed at the site of the relocated log boom to slow the dispersion of herbicides into untreated areas of Rock Slough. To limit the indirect effect of reduced DO concentrations, herbicides will be applied according to label instructions, which include provisions addressing the potential for low DO following treatment.

2. Blading and Discing of Rights-of-Way

There would be no direct or indirect effects to listed fish species from blading or discing rights-of-way as these activities solely occur on land. Direct effects to giant garter snake from these activities may include the following:

- Mortality or injury from vehicles or equipment or burial of giant garter snake within refugia (i.e. burrows).
- Reduction of prey species (e.g., frogs and earthworms) habitat.
- Loss of cover and refuge for juvenile giant garter snake.
- Temporary disturbance to giant garter snake and prey species.

Giant garter snake could be struck by the equipment conducting the blading and/or discing (e.g., dozer or tractor with implement). However, most of the upland areas at the RSFS are paved or are compacted, so the area requiring blading and discing is small. The likelihood of equipment strikes is low because vibration and noise from the equipment would likely cause giant garter snake to move away from the area. Equipment speeds will also be low (generally below 5 miles per hour in work area) which will allow more time for wildlife to avoid the direct path of the equipment. All work crews conducting blading and discing will complete an environmental awareness training program conducted by a USFWS-approved biologist.

Giant garter snake could be adversely affected when the burrows they may be occupying as refuge are crushed or collapsed during blading or discing. Giant garter snake are dormant and within burrows in the cooler winter months from November through March, and thus are the most vulnerable to mortality from burrow collapse during that time.

Discing activities from May 1 through October 1 would occur during the same period that the giant garter snake is most active. Conducting work during this period would reduce the likelihood of mortality from equipment strikes because the snake is more mobile and would quickly move away from equipment vibration and noise. Furthermore, because blading and discing occur near the Canal and Rock Slough, the snake is close to the water's edge. Giant garter snake commonly use water for escape cover. The likelihood of mortality from burrow collapse is low during the period of discing and blading since these activities would occur during the giant garter snake's most active period when it is not likely to be dormant in burrows. If work must occur from early October through April, CCWD shall adhere to the measures listed in Section 2.4.

Indirect effects to giant garter snake from blading and discing of rights-of-way may include the following:

- Loss of habitat, specifically bank-side vegetation used by giant garter snake for basking and cover.
- Reduction of prey species (i.e. frogs and earthworms) habitat.
- Increased predation of young giant garter snake by predatory birds and mammals due to lack of cover.
- Latent mortality from equipment strike injuries.

Giant garter snake relies on bankside vegetation for cover, which provides a thermal mosaic for basking so that the snake can thermoregulate its body temperature. When bankside vegetation is removed, this removes important cover that conceals the snake from predatory birds and mammals. In addition, immediately after birth, young giant garter snakes hide in thick vegetation to absorb their yolk sacs while concealed from predators. Removal of bankside vegetation also reduces the thermal gradient between vegetated and unvegetated areas that the giant garter snake moves between to regulate its temperature. After blading and discing has occurred, these indirect effects as well as latent mortality from vehicle and equipment strike injuries are possible.

Reduction of these effects is possible with environmental awareness training, pre-disturbance surveys, active monitoring during discing and blading activities, and limiting these activities to periods when the giant garter snake is most active in warm weather when they have the energy to quickly flee disturbance areas.

3. Blading of O&M Roads.

There would be no direct or indirect effects to listed fish species from blading O&M roads as these activities solely occur on land. Direct effects to giant garter snake from these activities may include the following:

- Mortality of or injury to giant garter snake from contact with blades and vehicles.
- Temporary disturbance to giant garter snake and prey species.
- Burial of giant garter snake within refugia (e.g., burrows on road shoulders).

If blading of roadways and shoulders is conducted during the giant garter snake's active period from May 1 through October 1, then the likelihood of strikes from equipment and vehicles is reduced because the snakes will likely be able to flee from the activity. The snakes are also less likely to be within burrows during the day, and thereby the chance that they would become trapped if burrows are collapsed is reduced. If blading of O&M roads occurs outside of the snake's active period, CCWD shall adhere to the measures listed in Section 2.4. Giant garter snake may cross roads when traversing from agricultural irrigation ditches to Rock Slough or back again, and this is when any potential vehicle or equipment strikes are most likely. The likelihood of mortality is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving.

Indirect effects to giant garter snake from blading of O&M roads may include the following:

- Latent mortality from contact with blades and vehicles.
- Removal of suitable burrows for giant garter snake's winter dormancy period.

Given that blading of O&M roads primarily takes place during the giant garter snake's most active period from May 1 through October 1, as well as during daylight hours when the snakes are either foraging within waterways or basking on vegetated banks, there is a low probability of equipment strikes injuring giant garter snakes. In addition, the dark coloration on giant garter snake stands out against the light colored unpaved roads that would need blading making them easily seen and avoided by equipment operators. The removal of ground squirrel burrows from blading would decrease potential winter refugia for giant garter snake, but given the abundance of burrows on the banks of Rock Slough opposite the RSFS where blading wouldn't occur, this reduction of burrows would be negligible.

4. Canal Bank Revegetation

There would be no direct or indirect effects to listed fish species from Canal bank revegetation as these activities solely occur on land. Direct effects to giant garter snake from these activities may include mortality or injury from scarifying levee banks with heavy equipment. Equipment strikes from gradalls, loaders, or klodbusters could potentially adversely affect giant garter snake, however, the likelihood of this is very low as this activity would occur on unvegetated banks where giant garter snake are not likely to be found. In addition, any giant garter snakes that are on the bank, would quickly flee to the water at any sign of disturbance avoiding potential injury or mortality.

Indirect effects to giant garter snake from Canal bank revegation may include the following:

- Damage or destruction of fossorial mammal burrows used by giant garter snake for refugia.
- Increased availability of giant garter snake habitat.
- Increased prey species (e.g., frogs and worms) within revegetated areas.

There is the potential that any fossorial mammal burrows on the banks would be damaged during revegetation activities, which reduces the abundance of winter refugia for giant garter snakes. If revegetation efforts use native, non-weedy species, including bulrush and cattails, this could counter balance the loss of winter refugia by increasing vegetated bank habitat used by giant garter snake for cover and as a thermal mosaic for temperature regulation. Revegetated banks would also likely increase the availability of prey species including earthworms, which are a key prey species for juvenile giant garter snakes, and bull frogs and chorus frogs that adult giant garter snake rely upon in addition to their fish diet.

5. Canal/Tunnel/Conduit Liner Repair

Direct effects to listed fish species and giant garter snake from Canal/tunnel/conduit liner repair activities may include the following:

- Mortality of or injury to listed fish species and giant garter snake.
- Disturbance to giant garter snake during its winter dormancy period.

All Canal/tunnel/conduit liner repair activities occur downstream of the RSFS. The RSFS's 2/32-in. mesh prevents entrainment of winter-run Chinook salmon, spring-run Chinook salmon, steelhead, green sturgeon, and most juvenile and all adult longfin and delta smelts. Larval smelts have been collected infrequently at both the Headworks (prior to construction of the RSFS) and behind the screen. From 1999 – 2015, only two smelts have been collected (Table 13). Larval and post-larval longfin smelt and delta smelt could be susceptible to entrainment based on length, breadth, size of the head capsule, and the way in which the larvae contact the screen. Once entrained, these larvae most likely do not survive to adulthood due to the large numbers of non-native predatory fish still present in the Canal. If by chance, survival did occur, later life stages of smelts would not able to migrate through the screen back to spawning grounds, and as a result they would essentially be lost to the population. There will be no direct effects to the other listed fish species and the later life stages of delta and longfin smelts from Canal/tunnel/conduit liner repair activities because they do not occur in the area downstream of the screen. Incidental take of entrained delta smelt has been previously covered by USFWS. Longfin smelt, if listed, will require coverage.

Direct effects to giant garter snake include the possibility of direct mortality or injury from crushing when canal/tunnel/conduit liner repair activities take place if the snakes use the voids beneath the liners as a winter dormancy refuge. However, this is not very likely, as the snakes typically use ground squirrel burrows above the high tide level on the banks of sloughs and canals.

There would be no indirect effects to listed salmonids, green sturgeon, and the later life stages of delta and longfin smelts from Canal/tunnel/conduit liner repair activities. Incidental take has already been provided for the entrainment of larval smelts.

Indirect effects to giant garter snake from Canal/tunnel/conduit liner repair activities may include latent mortality from injury as a result of conducting repairs. In the event a giant garter snake is injured, this could lead to lower fitness and eventual mortality.

8. Contact Terrestrial Herbicide Applications

Direct effects to giant garter snake and listed fish species from contact terrestrial herbicide applications may include the following:

- Mortality of giant garter snake could occur during herbicide application by contact with vehicles or large spray rigs. The likelihood of an equipment strikes is low because the disturbance from the equipment would likely cause giant garter snakes to flee the area to find escape cover habitat (often nearby water).
- Depending on application concentrations, giant garter snake could suffer direct mortality from terrestrial herbicide application, and listed fish species could be adversely affected if herbicides are inadvertently spilled into the water or if precipitation causes run off of herbicides into the Canal or Rock Slough. Giant garter snakes and listed fish species could be adversely affected by the application of herbicides if the effective concentration of the herbicide exceeds the species' toxicity tolerance.

Indirect effects to giant garter snake and listed fish species from contact terrestrial herbicide applications may include the following:

- Loss of bank vegetation used by giant garter snake to bask and as cover from predatory birds.
- Loss of habitat for giant garter snake (e.g., frogs and earthworms) and listed fish prey species (insects, etc.).

Removal of upland terrestrial vegetation could reduce the amount of suitable habitat for terrestrial prey species for listed fish species' and also giant garter snake. In addition, depending on the concentrations and toxicity of these herbicides, the abundance of these prey species may be reduced, leading to a reduction of suitable prey for juvenile giant garter snakes and some listed fish. Removal of bank-side terrestrial vegetation would reduce the amount of cover that the giant garter snake uses for cover and basking. This could lead to predation by predatory birds.

Most terrestrial vegetation that would require herbicide treatment is not found along the banks of waterways, and therefore its removal is not likely to affect giant garter snake.

If bank-side herbicide application is necessary, spot treatment with hand sprayers for precise application will reduce the chance of directly or indirectly affecting giant garter snake.

10. Canal Dewatering

Direct effects to listed fish species and giant garter snake from Canal dewatering activities may include the following:

- Mortality of or injury to larval and post-larval delta and longfin smelts and giant garter snake.
- Temporary disturbance to giant garter snake and prey species.

There would be no direct effects to listed salmonids and green sturgeon and the later life stages of delta and longfin smelts from Canal dewatering because this activity does not occur upstream of the RSFS and these species/life stages no longer occur downstream of the RSFS. Mortality of early life stages of longfin and delta smelts could occur if Canal dewatering occurs downstream of the RSFS during times when larvae could be present (January – June).

Direct mortality of giant garter snake could occur early during the likely work period (October through March) or near the end of this period. Giant garter snakes are typically dormant in underground burrows between November and March so they are unlikely to be directly affected by dewatering activities during this time.

When possible, CCWD will limit dewatering activities to occur during the giant garter snake's inactive period which is generally between November and March.

Although there would be no indirect effects to listed fish from Canal dewatering, indirect effects to giant garter snake from these activities may include the following:

- Latent mortality.
- Wet depressions in canals may be attractive to giant garter snake, their prey, and also to their predators; when reflooding occurs, individuals could be trapped or displaced from suitable habitat.

If dewatering activities injure giant garter snake by capture in dewatering pumps, latent mortality or lower fitness could potentially occur. Giant garter snake could also be attracted to wet depressions in the Canal that may contain stranded small fish. When the Canal is reflooded, this could sweep the snakes into unsuitable habitat. Again, most dewatering activities occur during the giant garter snake dormant period, so the probability of significant adverse indirect effects is low.

11. Drain, Ditch, and Channel Maintenance

Direct effects to listed fish species and giant garter snake from drain, ditch, and channel maintenance activities may include the following:

- Mortality of or injury to listed fish species and giant garter snake.
- Reduction in listed fish species and giant garter snake prey species as a result of increased noise and turbidity.

Drain, ditch, and channel maintenance activities occurring downstream of the RSFS would have the same effect to listed fish species as discussed under #5 Canal/Tunnel/Conduit Liner Repair. Therefore, drain, ditch, and channel maintenance activities occurring downstream of the RSFS would not affect listed salmonids and green sturgeon and the later life stages of delta and longfin smelts. Larval and post-larval delta and longfin smelt could be affected if maintenance is conducted downstream of the screen.

Maintenance activities that disturb sediments, increased turbidity may negatively affect listed fish species by clogging their gills, causing abrasions, and making it difficult to locate prey. Increased turbidity could result in decreased prey if these organisms die or if motile forms move out of the affected area. The effects of these maintenance activities are short term, temporary, and localized, and ambient conditions are anticipated to return soon after work is completed. Mortality of listed fish species could occur during drain, ditch, and channel maintenance activities occurring upstream of the RSFS.

Most of these activities can be conducted during the August through October time period before fall rains begin. This time period also coincides with the in-water work window for projects occurring in Rock Slough. Maintenance activities that can be scheduled should occur during the work window when listed fish species are not likely present. However, this work may need to be performed in the fall/winter/spring if storms create impacts to the area in front of the RSFS. It's possible that maintenance activities would be required outside of the in-water work window. In this case, mortality to listed species could occur.

If motorized boats are used during maintenance, propeller strikes could occur and adversely affect listed species. However, disturbance of the water by the boat and increased noise may cause listed species to temporarily leave the area. CCWD will operate boats at slow speeds, which will allow listed species to flee the area.

Mortality of giant garter snake could occur during drain, ditch, and channel maintenance activities both upstream and downstream of the RSFS.

The likelihood of mortality is significantly reduced if the work is conducted from August 1 through October 1, which is the narrowest work window considering both the snake's active period (May 1 through October 1) and the work window for listed fish (August 1 through October 31). Boat, vehicle, and other equipment strikes can cause direct mortality, but this work typically occurs during the warmer active periods of the snake. Furthermore, the likelihood of strikes is low because vibration and noise from vehicles and equipment would likely cause giant garter snake to move away from the area.

Giant garter snake is a visual hunter and increased turbidity may negatively impact the snake by reducing its success rate when foraging for fish. The effects of these maintenance activities are short term, temporary, and localized, and ambient conditions are anticipated to return soon after work is completed.

Indirect effects to listed fish species and giant garter snake from drain, ditch, and channel maintenance activities may include the following:

- Latent mortality of listed fish species and giant garter snake that could have been injured during maintenance activities.
- Reduction of giant garter snake prey species as a result of increased noise and turbidity.

Indirect effects to listed fish species and giant garter snake could occur if turbidity or noise is increased or if listed species are injured during these maintenance activities. If listed species do not move out of the area during maintenance activities, they could be injured to the degree that they would not survive. As discussed previously, increased noise and turbidity are localized, short term, and temporary, and the likelihood of fish and giant garter snake strikes is low.

It is important to note that many of these maintenance activities provide direct benefits to listed species. Removing large and small debris, which could provide cover for predatory fish, benefits listed species by reducing predator habitat. Removing soil and sediment that can build up offshore of the screen and increase approach velocities benefits listed fish species by keeping the screen clear so that approach velocities meet Agency requirements. Removal of trash also provides benefits to listed species by providing higher quality habitat.

Indirect effects to giant garter snake could occur as a result of increased turbidity or disturbance that could reduce the availability or success rate of foraging for fish. As discussed above, increased noise and turbidity are localized, short term, and temporary, and snakes can, and often do, go long periods without food. Many of these activities are expected to improve conditions for native fish and reduce the number of predatory fish; therefore, the overall impact would likely benefit giant garter snake.

13. Hand and Mechanical Control of Vegetation
Direct effects to listed fish species and giant garter snake from hand and mechanical or hand control of vegetation may include the following:

- Mortality of or injury to listed fish species and giant garter snake from harvester strikes or entanglement in removed vegetation.
- Mortality of giant garter snake from hand removal of terrestrial vegetation.
- Reduction of aquatic prey species.
- Temporary disturbance to listed fish species, giant garter snake, and prey species.

Mortality of listed fish species and giant garter snake could occur during mechanical harvesting of the aquatic weeds upstream of the RSFS if fish become entangled in the vegetation and removed from the water, or are struck by the harvesting equipment. Prey could be removed with the vegetation or could move out of the area and not be available to listed species. It is important to note that listed fish species were rarely collected even outside of the June 1 through October 31 time period during Rock Slough Headworks fish monitoring. Sieve net monitoring data from Rock Slough Headworks from 1999 – 2009 (Table 13) prior to construction of the fish screen show that no juvenile or adult winter-run Chinook salmon, green sturgeon, or longfin smelt were collected during the 11 years of data examined. Spring-run Chinook salmon (n=11) and steelhead (n=15) were collected only during February through May, and the single delta smelt was collected in February. Therefore, based on the data, the likelihood of affecting listed fish species remains low in the month of January, and from June through December[12]. Giant garter snake is also expected to be in its winter dormancy period from November through March and is not likely to be adversely affected by the harvesting equipment during this period. When hand and mechanical control of vegetation is required outside this period, pre-disturbance surveys, environmental awareness training programs and biological monitors will help to ensure adverse effects to giant garter snake are minimized. The purpose of conducting surveys is to identify the presence of giant garter snakes so that further measures can be taken to avoid or minimize adverse effects to them. It should be noted that the lack of detection of giant garter snake during surveys does not guarantee that the species is absent from the work area. Giant garter snake, because of their wary and secretive nature, are difficult to detect visually.

Prior to mechanical harvesting upstream of the RSFS, one side of the log boom and block net (if deployed) would be released from the anchor and the boom and the net would be pulled to the shoreline to allow fish to leave the area. Mechanical harvesting would begin closest to the Rock Slough Extension, would proceed past the fish screen, and continue approximately 100 – 200 feet beyond the location of the relocated log boom. Increased noise and disturbance of the water during harvesting, the slow speed of the harvester (approximately two miles per hour), and beginning harvesting closest to the Extension and moving toward Rock Slough would allow fish and any potentially non-dormant giant garter snake to move into the unaffected area of Rock Slough. Harvesting offshore of the RSFS is anticipated to take approximately four days (1 day per acre). Effects to listed species from hand or mechanical harvesting are short term, localized, and temporary. CCWD's methodology for harvesting provides fish and giant garter snake an escape route.

The area of the afterbay to be harvested is approximately two acres and would take approximately two days to complete. When mechanical harvesting is conducted in the RSFS afterbay, it is unlikely to result in mortality to listed salmonids, green sturgeon, and the later life stages of smelts. Incidental take of entrained delta smelt and longfin smelt is already covered. The afterbay is also not suitable habitat for giant garter snake as its banks are composed of rip rap and concrete. Therefore, giant garter snake is not likely to be adversely affected by harvesting operations within the afterbay.

Water hyacinth and water primrose are documented as good quality foraging and breeding (young rearing) habitat for giant garter snake in non-dormancy periods from March through early November. From July through September, females bear young which quickly take cover in vegetation away from the water to absorb their yolk sacs and avoid predatory fish. If hand and mechanical removal of vegetation is scheduled to occur within the active or breeding periods of giant garter snake (March through September) then adverse impacts to giant garter snake may occur. If vegetation removal must take place during the active and/or breeding period of giant garter snake, pre-disturbance surveys, environmental awareness training for workers, and biological monitoring will minimize adverse effects to giant garter snake.

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[12] Fall-run Chinook salmon have been documented to occur offshore of the RSFS in November and December. Although this run is not listed, it is covered under the Pacific Salmon FMP, and has designated Essential Fish Habitat.

Hand removal (e.g., tool aided) of terrestrial vegetation may result in mortality of giant garter snake by an inadvertent strike. However, noise from and disturbance from activity may cause giant garter snake to leave the area. Since terrestrial control of weeds is done by hand, workers will visually inspect the area while work is being conducted. Therefore, the risk of mortality or injury is reduced.

Indirect effects to listed fish species and giant garter snake from hand and mechanical vegetation harvesting may include the following:

- Latent mortality of injured listed fish species and giant garter snake.
- Loss of giant garter snake cover and foraging areas from removal of aquatic and bank edge vegetation.

Listed fish species and giant garter snake could be injured during mechanical harvesting and die later from their injuries from infection or predation. As discussed previously, the effects of hand and mechanical harvesting vegetation control are short term, localized, and temporary. It is anticipated that ambient conditions would return soon after mechanical harvesting is completed. Removal of bank-side and emergent aquatic vegetation will reduce cover and foraging area for giant garter snake and could reduce rearing habitat for juvenile giant garter snake.

14. Insecticidal Sprays

Direct effects to listed fish species and giant garter snake from application of insecticidal sprays may include the following:

- Mortality of or injury to giant garter snake and listed fish species through contact with potentially toxic insecticide concentrations.
- Mortality of or injury to giant garter snakes by vehicle or equipment strikes.

Depending on application concentrations and the amount of disturbance during application, giant garter snake could suffer direct mortality or injury from insecticide application. Listed fish species could also be adversely affected if insecticidal sprays are inadvertently spilled into the water or if precipitation causes run off of insecticides into the Canal or Rock Slough. Giant garter snake and listed fish species could be adversely affected by the application of insecticides if the effective concentration of the insecticide exceeds the species' toxicity tolerance. CCWD will follow procedures to ensure that no insecticides are spilled into the waters of the Canal or Rock Slough and no insecticides will be applied prior to forecasted rain.

Mortality of giant garter snake could occur during insecticide application. Giant garter snake could be struck by vehicles or spray equipment. The likelihood of vehicle strikes is low because vibration and noise from the vehicles would likely cause giant garter snake to move away from the area. Vehicle speeds will also be slow (15 mph) which will allow time for snakes to avoid the direct path of the equipment. All workers will complete an environmental awareness training program conducted by a USFWS-approved biologist and will watch for snakes while driving.

Indirect effects to giant garter snake and listed fish species from application of insecticidal sprays may include the following:

- Reduction in prey species by elimination of lower trophic levels.
- Bioaccumulation of toxins within the food chain concentrating in giant garter snakes and listed fish species.

Listed fish species and giant garter snake could be indirectly affected by insecticide application. Giant garter snakes do not eat insects. However, if insecticidal treatments also adversely affect annelids (segmented worms), this could lead to a reduction in abundance of prey for juvenile giant garter snake that prey primarily on earthworms. In addition, insects are prey for frogs and fish which if reduced, could lower the abundance of these prey species also relied upon by adult giant garter snake and some listed fish species. Bioaccumulation of toxins within the food chain could also potentially concentrate within giant garter snakes and listed fish species leading to delayed mortality or reduced fitness. Based on the analysis of direct and indirect effects presented above, insecticidal spraying may have adverse indirect effects on giant garter snakes and listed fish species depending on application amounts and if insecticides enter the waters of the Canal or Rock Slough.

Efforts will be made to reduce the use of insecticides to the lowest level necessary to achieve the goals of the application. The adverse indirect effects to giant garter snake can be further reduced by not applying insecticidal sprays adjacent to waterways or on levee banks and by using insect traps, flypapers (elevated), or electric bug zappers as opposed to chemical insecticides. CCWD will follow procedures to ensure that no insecticides enter the waters of the Canal or Rock Slough.

15. Mudjacking and/or Injecting Grout

The only in-water mudjacking or injecting grout activities that could affect listed fish species would occur on a small section of concrete liner upstream of the Headworks Structure. There would be no indirect effects to listed fish from mudjacking or injecting grout activities other than to larval smelts if they are present and affected during this maintenance activity.

Direct effects to giant garter snake from mudjacking or injecting grout activities may include the following:

- Mortality of or injury to giant garter snake from filling in gaps in the rip rap and filling fossorial mammal burrows that may contain giant garter snake.
- Temporary disturbance to giant garter snake and prey species.

Giant garter snakes have been reported to bask on rip rap, however this is not ideal habitat for the species. As such, it is possible, although highly unlikely, that giant garter snake may become injured, trapped, or suffer mortality by filling in gaps in rip rap. Giant garter snake could be adversely affected if fossorial burrows are filled. If work occurs during the snake’s inactive period (early October through April) a pre-disturbance survey will be conducted by a qualified biologist, and fossorial mammal burrows will be marked and avoided if possible. The purpose of conducting surveys is to identify the presence of giant garter snakes so that further measures can be taken to avoid or minimize adverse effects to them. It should be noted that the lack of detection of giant garter snake during surveys does not guarantee that the species is absent from the work area. Giant garter snake, because of their wary and secretive nature, are difficult to detect visually.

Vehicle and equipment vibration and noise may temporarily disturb giant garter snake. However, the area between the Headworks Structure and the RSFS is not ideal giant garter snake habitat, and as a result the likelihood for direct effects is very low.

Indirect effects to giant garter snake from mudjacking or injecting grout activities may include the following:

- Removal of refuge areas under rip rap used by giant garter snake to avoid predation by raptors and egrets
- Removal of fossorial mammal burrows used by giant garter snake as refugia.

As discussed above, giant garter snake has been documented to utilize rip rap to bask in the sun and may potentially use the voids and crevices as refuge from predators. However, the area where work may occur is not ideal giant garter snake habitat, and therefore, the likelihood of indirect effects to the species is low.

16. Pre-emergent Herbicide Applications

Direct effects to giant garter snake and listed fish species from pre-emergent herbicide applications may include the following:

- Mortality of or injury to giant garter snake from vehicle or equipment strikes.
- Mortality of or injury to giant garter snake and listed fish species from potentially toxic herbicide concentrations.

If application of pre-emergent herbicides coincides with the giant garter snake's active period from May 1 through October 1, there is the potential for vehicle or equipment strikes that could result in mortality. Strict adherence to the 15 mph speed limit and observing the road for snakes while driving will significantly decrease the likelihood of vehicle strikes. In addition, though not likely to reach high enough concentrations, herbicides could potentially cause direct mortality of snakes if applied directly to juvenile giant garter snakes that are hiding in crevices and the toxicity exceeds the species' tolerance. As most applications are usually applied in late-fall or early-winter when giant garter snake begin to enter their winter dormancy period, the potential for vehicle or equipment strikes is low. Juvenile giant garter snake are not present at this time.

Listed fish species could be adversely affected by pre-emergent herbicide applications if the herbicides inadvertently enter the water, and the toxicity of the herbicide exceeds the species' toxicity tolerance. CCWD will follow procedures described in Section 2.4.3 to ensure that no pre-emergent herbicides are spilled into the waters of the Canal or Rock Slough, and no herbicides will be applied prior to forecasted rain.

Indirect effects to giant garter snake and listed fish species from pre-emergent herbicide applications may include the following:

- Latent mortality of giant garter snake and listed fish species.
- Loss of vegetation used as basking sites or for cover from predation for giant garter snake.
- Reduction of prey species habitat.

Listed fish species could be indirectly affected by pre-emergent herbicide application. Reduction of bank side vegetation could reduce the terrestrial insects that may provide prey for some listed species.

Pre-emergent herbicide application could potentially reduce prey species abundance (annelids) for juvenile giant garter snake because the removal of vegetation also leads to a reduction in soil moisture and friability required by annelids. Reduction in bankside vegetation also removes valuable cover and basking sites for giant garter snakes and reduces available habitat for their terrestrial prey species.

18. Rights-of-Way Dust Abatement

There would be no direct or indirect effects to listed fish species from right-of-way and construction laydown dust abatement activities as they occur solely on land. Direct effects to giant garter snake from this activity may include the following:

- Mortality of or injury to giant garter snake from contact with water trucks.
- Temporary disturbance to giant garter snake and prey species.

Water trucks may cause mortality to giant garter snake through contact with the trucks. The likelihood of running over snakes is low because vibration and noise from the trucks would likely cause giant garter snake to move away from the area. The likelihood of mortality is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving.

Indirect effects to giant garter snake from rights-of-way dust abatement activities may include latent mortality. Injured giant garter snake may suffer from latent mortality or reduced fitness due to vehicle strikes. Injury to giant garter snake can be minimized by strict adherence to the 15 mph speed limit, environmental awareness training of work crews, and observing the road while driving. The likelihood of equipment strikes is low because vibration and noise from the vehicles or equipment would likely cause giant garter snake to move away from the area.

19. Rights-of-Way Mowing

There would be no direct or indirect effects to listed fish species from right-of-way mowing as these activities only occur on land. Direct effects to giant garter snake from these activities may include the following:

- Mortality of or injury to giant garter snake from vehicle or equipment strikes.
- Temporary disturbance to giant garter snake from mowing equipment vibration or noise.

Equipment used during rights-of-way mowing may cause mortality or injury to giant garter snake through direct contact. The likelihood of running over snakes is low because vibration and noise from the equipment would likely cause giant garter snake to move away from the area. The likelihood of mortality or injury is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving. If possible, scheduling activities to occur during the time when the giant garter snake is active would significantly reduce chances of affecting giant garter snake.

Indirect effects to giant garter snake from rights-of-way mowing may include latent mortality. Injured giant garter snake may suffer from latent mortality or reduced fitness due to vehicle or equipment strikes. Injury to giant garter snake can be minimized by strict adherence to the 15 mph speed limit, environmental awareness training of work crews, and observing the road while driving. The likelihood of equipment strikes is low because vibration and noise from the vehicles or equipment would likely cause giant garter snake to move away from the area.

20. Rip Rap

Direct effects to listed fish and giant garter snake from activities involving placement of rip rap may include the following:

- Mortality of or injury to listed fish species and giant garter snake from being buried or struck by falling rip rap.
- Mortality of or injury to giant garter snake from vehicle or equipment strikes.
- Temporary disturbance to giant garter snake and prey species.

There would be no direct take of listed fish species during times when rip rap work is conducted above mean high tide, unless rip rap inadvertently entered the water and crushed a fish. Any activities involving rip rap that occur downstream of the screen would not affect listed salmonids, green sturgeon and the later life stages of delta and longfin smelts. Early life stages of delta and longfin smelts could be affected if they are present in the afterbay during activities involving rip rap. Direct take could occur upstream of the RSFS if activities take place below mean high tide and listed fish species are present in the area. However, noise from equipment may cause listed fish species to avoid the work area.

Giant garter snake could potentially be struck by vehicles or equipment or crushed during rip rap installation. The likelihood of equipment strikes or burial during rip rap placement is low because vibration and noise from the equipment or rip rap installation would likely cause giant garter snake to move away from the area. The likelihood of mortality or injury is significantly reduced by strict adherence to the 15 mph speed limit, careful observation of the road while driving, and observation of the area during placement of rip rap.

Indirect effects to listed fish and giant garter snake from activities involving placement of rip rap may include the following:

- Latent mortality of listed fish and giant garter snake.
- Slight changes in water quality occurring over time depending on the type of rip rap installed and from increased particulate matter entering Rock Slough.
- Loss of a natural thermal mosaic for giant garter snake.
- Degradation and pollution of water.

- Loss of fossorial mammal burrows used by giant garter snake as winter dormancy refuge if installed in conjunction with an impermeable ground cloth.

Indirect effects to listed species could occur through slight changes in water quality from increases in particulate matter and changes in chemical composition due to new rip rap. These indirect effects could only occur when work is conducted below the ordinary high water mark, or if new rip rap placed above the ordinary high water mark gets wet during rain events and water carrying the particulate matter runs into Rock Slough. These slight changes in water quality and the addition of particulate matter would be short term, temporary, and localized. The volume of water from precipitation that would enter Rock Slough from the affected area is quite small in relation to the volume of water in the Canal and Rock Slough. Therefore, the indirect effects to listed species would be insignificant.

Injured giant garter snake may be subject to latent mortality or reduced fitness as a result of the placement of rip rap. Banks that are rip rapped lose their natural thermal mosaic utilized by giant garter snake for thermoregulation. Dust from rip rap can temporarily increase turbidity levels within the water potentially lowering the success rate of aquatic foraging for giant garter snake and listed fish species. California ground squirrels often dig their burrows directly under rip rap, concrete rubble, and other non-natural substrates; burrows can be used by giant garter snake. If rip rap is installed over an impermeable ground cloth, like that used to prevent weed growth, this could reduce the number of available burrows used by giant garter snake for winter dormancy refuge.

22. Squirrel Baiting
There would be no direct or indirect effects to listed fish species from squirrel baiting as they occur solely on land. Giant garter snakes do not feed on ground squirrels or on grain baits, and therefore, there would be no direct effects from rodenticide baiting with pelletized baits or edible baits such as Diphacinone treated grain.

Indirect effects to giant garter snake from squirrel baiting may include reduction in abundance of fossorial mammal burrows available for winter dormancy refuge. Giant garter snakes utilize ground squirrel burrows for winter dormancy refuge and to escape heat on hot summer days. A reduction of ground squirrels, in conjunction with collapsing burrows, would remove suitable winter dormancy refuge for giant garter snake. However, ample burrows exist on the southern shoreline of the RSFS. Therefore, the indirect effects are insignificant.

23. Bargate/Fence Installations
There would be no direct or indirect effects to listed fish species from bargate and fence installation activities as they occur solely on land. Direct effects to giant garter snake from these activities may include the following:

- Mortality of or injury to giant garter snake if an auger or backhoe damages or destroys an occupied burrow.
- Temporary disturbance to giant garter snake and prey species.

Bargate and fence installation work, if possible, will be scheduled to occur during the snake's active period from May 1 through September, which would limit direct effects. If work occurs during the snake's inactive period, there is a potential for direct mortality if auguring takes place near ground squirrel burrows and results in collapse or otherwise damages a burrow containing a dormant giant garter snake. Equipment noise and vibration may temporarily disturb a dormant giant garter snake causing them to avoid the area, which reduces the direct effects, but may increase the indirect effect by displacement from dormancy refugia. When traveling to the work site, the likelihood of mortality or injury is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving.

Indirect effects to giant garter snake from bargate and fence installation may include the following:

- Latent mortality.
- Potential reduction in available burrows for winter dormancy refuge.

Injured giant garter snake may have reduced fitness or succumb to their injuries if activities collapse an occupied dormancy refuge burrow. Bargate and fence installation may reduce the number of available refuge areas. However, many burrows exist on the shoreline opposite the RSFS, so the likelihood of effects is reduced.

24. Bridge Maintenance (running pad replacement)

Direct effects to listed fish and giant garter snake from bridge maintenance may include the following:

- Mortality of or injury to listed species from wash water and paint entering the Canal or Rock Slough.
- Increased turbidity during removal and replacement of support pillars, and increased sound from driving pillars.
- Reduction or disturbance of the prey of listed fish species.
- Mortality of giant garter snake from wash water and paint entering Rock Slough, increased turbidity lowering successful foraging within aquatic habitats, disturbance from vibration due to pillar driving.
- Temporary disturbance to giant garter snake and prey species.

Mortality of or injury to listed fish species or their prey is unlikely to occur during bridge maintenance activities. Wash water and accidentally spilled paint entering Rock Slough or the Canal could result in temporary changes to water quality; however, the amount of paint and wash water that could enter the water is small relative to the volume of Rock Slough and the afterbay. Paint will only applied by brush, roller, or by hand and only small amounts of paint (typically less than a gallon) could accidentally be spilled into the water. Changes to water quality would be temporary, short term, and localized, and therefore mortality of or injury to listed fish species is not anticipated from painting and pressure washing activities. Increased turbidity from removal and replacement of support pillars and increased sound from driving pillars could also negatively affect listed fish species. If possible, CCWD will conduct removal and placement of support pillars during the in-water work window from August 1 through October 31, when listed fish species are not expected to be in the vicinity. If a situation occurs and support pillars must be removed and replaced outside of the in-water work window, work would be conducted on an incoming tide if possible, and a silt curtain would be used. No take of any life stage of listed salmonids, green sturgeon, and adult and juvenile delta and longfin smelts is anticipated when work is conducted at the Headworks or the Flood Isolation structures because these species/life stages are no longer found downstream of the RSFS. If any larval or post-larval delta or longfin smelts are present in the afterbay, they are considered lost to the population because they are not able to migrate back through the RSFS.

Giant garter snake is a visual predator, and therefore a temporary increase in turbidity from driving support pillars could reduce its successful foraging in the affected area. It is likely, however; that this disturbance would cause any giant garter snake to temporarily leave the area, where they would be less likely to encounter higher turbidity levels. Potential paint spills could result in temporary changes to water quality that may affect prey species relied upon by giant garter snake; however, these effects would be short term, temporary, and localized and are likely to be insignificant. Since the majority of the proposed activities typically occur during the giant garter snake's active period (May 1 through October 1), any giant garter snake in the area would likely flee due to vibration, noise, and disturbance from vehicles and equipment.

Indirect effects to listed fish and giant garter snake from activities involving bridge maintenance may include the following:

- Latent mortality of listed fish and giant garter snake
- Changes in water quality that could affect listed species over time

Listed fish or giant garter snake could be injured and later die due to infection or increased predation. Changes to water quality are expected to be short term, localized, and temporary. Ambient conditions are anticipated to return soon after maintenance is completed.

25. Cableway Maintenance (painting/cleaning/repair)

Direct effects to listed fish species and giant garter snake from cableway maintenance activities may include mortality of or injury to listed fish species, giant garter snake, and their prey from lubricants and paint accidentally spilled offshore of the RSFS. Mortality of or injury to listed fish species and giant garter snake is unlikely to occur during cableway maintenance activities. Lubricants and paint accidentally spilled into Rock Slough could result in temporary changes to water quality that could affect listed fish species, giant garter snake, and their prey; however, the amount of paint and lubricants that could enter the water during maintenance activities is small relative to the volume of Rock Slough. Paint is only applied by brushes and only small amounts of paint (typically less than a gallon) could accidentally be spilled into the water. CCWD will use best management practices to ensure that paints and lubricants do not enter the water. Containment booms will be available and will be used in the unlikely case that lubricants are spilled in the water. Changes to water quality would be temporary, short term, and localized, and therefore mortality of listed fish species and giant garter snake is not anticipated from painting and lubricating activities.

Indirect effects to listed fish species and giant garter snake from cableway maintenance activities may include latent mortality of listed fish species, giant garter snake, and their prey. Lubricants and paint accidentally entering Rock Slough could result in latent mortality of listed fish species, giant garter snake, and their prey. As discussed above, changes in water quality would be short term, temporary, and localized, and therefore the indirect effects are anticipated to be minor.

29. Drainage Improvements (ditches or pipe)

There will be no affect to listed fish species as drainage ditch or pipe improvement activities do not occur within Rock Slough or the Canal. Direct effects to giant garter snake from these activities may include the following:

- Mortality or injury from vehicles or equipment if work is occurring adjacent to aquatic areas or if ground squirrel burrows are present in the work area.
- Trenches can act as pitfall traps if left open or without escape ramps.
- Earthwork can damage or destroy burrows used by giant garter snake as refugia.

Vehicle or equipment strikes may cause direct mortality to giant garter snakes. The likelihood of running over snakes is low because vibration and noise from vehicles and equipment would likely cause giant garter snake to move away from the area. The likelihood of mortality is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving. If possible, CCWD will conduct the improvements during the snake's active period (May 1 through October 1).

Indirect effects to giant garter snake from drainage ditch or pipe improvement activities may include the following:

- Latent mortality from vehicle or equipment strikes.
- Removal of burrows reduces the availability of refugia.

Injured giant garter snake may suffer from latent mortality or reduced fitness due to vehicle or equipment strikes. Ground squirrels generally quickly replace burrows that are covered or collapsed, therefore the reduction of burrow abundance would likely be a temporary effect.

30. Electrical Repairs by Utility Companies (PG&E, WAPA, or others)

There will be no affect to listed fish species from electrical repairs by utility companies as these activities do not occur in Rock Slough or in the Canal. Direct effects to giant garter snake from electrical repairs by utility companies may include the following:

- Mortality or injury from vehicle or equipment strikes.
- Excavating can disturb or damage burrows and potentially harm occupants including giant garter snake.

Equipment strikes may cause direct mortality to giant garter snakes. The likelihood of striking snakes is low because vibration and noise from vehicles and equipment would likely cause giant garter snake to move away from the area. The likelihood of mortality from vehicles or equipment is significantly reduced by strict adherence to the 15 mph speed limit and observing the road while driving. If work by the utility company occurs during the snake's inactive period, snakes could suffer mortality or injury.

Indirect effects to giant garter snake from electrical repairs by utility companies may include latent mortality. Injured giant garter snake may suffer from latent mortality or reduced fitness due to vehicle or equipment strikes or damage to burrows. Following the measures listed in Section 2.4 will reduce the likelihood of injury.

31. Embankment Maintenance (filling washes and gullies)

There will be no affect to listed fish species as embankment maintenance activities would not affect the waters of the Canal or Rock Slough. Direct effects to giant garter snake from embankment maintenance activities may include the following:

- Mortality or injury from vehicle or equipment strikes.
- Mortality from collapsing burrows that are occupied by giant garter snake during winter dormancy period.
- Temporary disturbance to giant garter snake and its prey.

Excavation and fill of gullies and burrows, compacting soils, and grading slopes can result in mortality of giant garter snake that are hidden in vegetation or dormant within burrows in levee banks. Trucks and vehicles may cause direct mortality or injury from striking a giant garter snake. Direct effects to giant garter snake can be reduced by conducting pre-disturbance surveys if embankment maintenance is conducted during the snake's inactive period, providing an environmental awareness training program, and by maintaining a biological monitor on site during embankment maintenance activities. The purpose of conducting surveys is to identify the presence of giant garter snakes so that further measures can be taken to avoid or minimize adverse effects to them. It should be noted that the lack of detection of giant garter snake during surveys does not guarantee that the species is absent from the work area. Giant garter snake, because of their wary and reclusive nature, are difficult to detect visually. The likelihood of mortality is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving.

Activities utilizing heavy equipment, such as excavators and compactors, may create enough disturbance (noise and vibration) that giant garter snake would likely temporarily leave the work area once ground disturbance activities begin.

Indirect effects to giant garter snake from embankment maintenance activities may include the following:

- Latent mortality.
- Damage to burrows that can reduce overwintering refugia.

Injured giant garter snake may have reduced fitness or may succumb to their injuries. Destruction of ground squirrel burrows would cause a reduction in available winter dormancy refuge sites for giant garter snakes; however, ground squirrels typically replace lost burrows quickly, which reduces the indirect effects to giant garter snake.

32. Facilities Inspection

Direct effects to listed fish species and giant garter snake from facilities inspection may include mortality, injury, and disturbance of listed fish species, giant garter snake, and reduction in prey. Direct mortality or injury of listed fish species and giant garter snake could occur through boat propeller strikes if motorized boats are used to inspect facilities. Boat noise and disturbance of the water may cause listed fish species and giant garter snake to avoid or vacate the area during facilities inspections. CCWD will operate boats at slow speeds, which will allow fish and giant garter snake to flee the area. Giant garter snake could be struck by vehicles. The likelihood of mortality is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving. Mechanical testing of equipment may also disturb listed species and their prey. The effects of facilities inspection are short term, localized, and temporary. It is anticipated that ambient conditions will return shortly after the inspection ceases. No juvenile or adult listed fish species are present downstream of the RSFS in the area of where inspections could occur at the Headworks and the Flood Isolation structures. If larval smelts are present in the afterbay, they could be affected during in-water inspection of the Headworks and Flood Isolation structures.

Indirect effects to listed fish species and giant garter snake from facilities inspection may include latent mortality. If listed fish species and giant garter snake do not move out of the area during maintenance activities, they could be injured. Injury could increase the chances of infection and predation.

33. Graffiti Removal from Concrete Structures

Currently, no direct or indirect effects to listed fish species or giant garter snake are anticipated from graffiti removal. The Headworks Structure, Flood Isolation Structure, and the RSFS are within the alarmed secured area of the RSFS Facility. Offshore access to the RSFS is blocked by the relocated log boom. Therefore, graffiti does not occur within the Project area requiring its removal. However, once the adjacent property is residentially developed, the potential for graffiti occurring will increase; therefore, direct and indirect effects to listed species are assessed.

Direct effects to listed species from removal of graffiti may include the following:

- Mortality or injury of listed fish species and giant garter snake from propeller strikes, increased turbidity from sandblasting, and possible contamination of water through spillage of products.
- Temporary disturbance to listed fish species and giant garter snake prey.

Mortality or injury could occur to listed fish species during graffiti removal of the upstream side of the fish screen if motorized boats are used and species are struck by propellers. However, CCWD will operate boats at slow speeds, which will allow fish and giant garter snake to flee the area. For work conducted at the Headworks or the Flood Isolation structures, no mortality of listed salmonids, green sturgeon, or later life stages of delta and longfin smelts is anticipated since these species/life stages no longer occur in the RSFS afterbay. Mortality of larval and post-larval delta and longfin smelts could occur if they are present during graffiti removal activities; however, as previously discussed, these larvae are lost to the population once they are entrained. Incidental take of entrained delta smelt and longfin smelt has been previously covered. Mortality of or injury to giant garter snake could also occur from propeller strikes if work is conducted during the active period (May 1 through October 1). Turbidity may be increased during sandblasting from sand entering Rock Slough and the afterbay. Accidental spills of waste paint and new paint could contaminate waterways and affect listed species. CCWD will take precautions to ensure that waste paint and new paint are not spilled into the water or on land. Activities may also temporarily disturb the prey of listed fish species and giant garter snake. Because these activities are short term, localized, and temporary, ambient conditions are expected to return shortly after graffiti removal activities end.

Indirect effects to listed species from graffiti removal at the Headworks/Flood Isolation/RSFS structures may include latent mortality of listed species and its prey. Latent mortality could occur if listed fish species or giant garter snake are injured during graffiti removal. Injury could increase the chances of infection and predation.

34. Guardrail Installation/Repair

There will be no direct or indirect effects to listed fish species from guardrail installation as these activities occur on land. Direct effects to giant garter snake from these activities may include the following:

- Mortality or injury from vehicle or equipment strikes.
- Temporary disturbance to giant garter snake and prey species.

Vehicle and equipment strikes may cause direct mortality or injury of giant garter snakes. The likelihood of equipment strikes is low because vibration and noise from vehicles or equipment would likely cause giant garter snake to move away from the area. The likelihood of mortality is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving. The effects of repair and replacement activities are short term, localized, and temporary. It is anticipated that ambient conditions will return shortly after the repair and replacement activities cease.

Indirect effects to giant garter snake from guardrail installation/repair activities may include the following:

- Latent mortality.
- Potential for soil disturbance to damage or destroy burrows potentially used as refugia.

Giant garter snake may die of their injuries or sustain a reduced level of fitness. Destruction of ground squirrel burrows can reduce the abundance of winter dormancy refuge for giant garter snake, but this work is not likely to be conducted in ideal giant garter snake habitat and ground squirrels typically replace lost burrows quickly making any disturbance even more temporary.

35. Valve Rehabilitation

There will be no affect to listed fish species as all valve rehabilitation activities take place on land. Direct effects to giant garter snake from valve rehabilitation may include the following:

- Mortality or injury from vehicle or equipment strikes.
- Temporary disturbance to giant garter snake and prey species.

Contact with vehicles or equipment strikes may cause direct mortality or injury to giant garter snakes. The likelihood of equipment strikes is low because vibration and noise from vehicles and equipment would likely cause giant garter snake to move away from the area. The likelihood of mortality is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving.

Indirect effects to giant garter snake from valve rehabilitation may include latent mortality. Giant garter snake may die of their injuries or sustain a reduced level of fitness.

36. Ladders/Safety Nets/Float/Log Boom Repair and Replacement

Direct effects to listed fish species and giant garter snake from repair and replacement activities may include the following:

- Mortality of or injury to listed fish species and giant garter snake.
- Disturbing the water column could affect the prey of listed fish species and giant garter snake.

Mortality of listed fish species and giant garter snake could occur through entanglement in nets or boat propeller strikes during repair and replacement activities. However, CCWD will operate boats at slow speeds, which will allow listed fish species and giant garter snake to flee the area. Repair and replacement activities are unlikely to have a direct effect on listed species except through disturbance of the water column, which could affect all species and their prey. Boat noise and disturbance of the water may cause listed fish species and giant garter snake to avoid or vacate the area during these activities. The magnitude of this effect would be insignificant, however, as repair and replacement activities would be infrequent. In any case, the effects of repair and replacement activities are short term, localized, and temporary. It is anticipated that ambient conditions will return shortly after the repair and replacement activities ceases. If repair and/or replacement activities occur during the snake's active period (May 1 through October 1), CCWD shall adhere to the measures listed in Section 2.4.

Indirect effects to listed fish species and giant garter snake from repair and replacement activities may include latent mortality. Listed fish species and giant garter snake could die from injuries sustained during repair and replacement activities. However, noise and disturbance of the water column would likely cause listed species to temporarily leave the area, so injury to listed species is not likely.

37. Pull and Check Pumps

No direct or indirect effects to listed fish species or giant garter snake are anticipated during pulling and checking of pumps. Although the pumps are in the water, they are enclosed in casings, and all inspections and testing are done on land.

39. Instrument Recorder House Maintenance (door repair, painting, cleaning, etc.).

There would be no direct or indirect effects to listed fish species or giant garter snake during recorder house maintenance because this task occurs on land and the area is paved.

40. Removal of Trash or Debris.

Direct effects to listed fish species and giant garter snake from removal of trash or debris may include the following:

- Mortality of or injury to listed fish species and giant garter snake.
- Temporary loss of prey.

Mortality of or injury to listed fish species and giant garter snake could occur through boat propeller strikes during removal of trash or debris offshore of the RSFS. However, CCWD will operate boats at slow speeds, which will allow fish and giant garter snake to flee the area. Mortality of or injury to giant garter snake could also occur from heavy equipment or vehicles. The likelihood of mortality is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving. Boat noise and disturbance of the water may cause listed fish species, giant garter snake, and their prey to avoid the area during these activities; vibration and noise from heavy equipment and vehicles may cause giant garter snake to temporarily leave the area. The magnitude of these effects would be small, however, as trash and debris removal would be infrequent. In addition, the effects of trash and debris removal are short term, localized, and temporary. It is anticipated that ambient conditions will return shortly after the trash and debris removal ceases. Therefore, direct mortality of or injury to giant garter snake and listed fish species is highly unlikely to occur.

Indirect effects to listed fish species and giant garter snake from removal of trash or debris may include latent mortality. Latent mortality could occur if listed species die from injuries sustained during trash and debris removal. However, injury is unlikely because noise and vibrations may cause listed species to temporarily leave the area.

It is important to note that removal of trash and debris benefits listed species by reducing materials that could be toxic or that could injure listed species. Large debris or trash could provide cover for predatory fish, and removing this cover would benefit listed fish species and giant garter snake.

41. Rights-of-Way Trash Removal

There would be no direct or indirect effects to listed fish species during rights-of-way trash removal because this task occurs on land. Direct effects to giant garter snake from removal of trash in rights-of-way may include the following:

- Mortality or injury from vehicle or equipment strikes.
- Temporary disturbance to giant garter snake and prey species.

The likelihood of vehicle or equipment strikes is low because vibration and noise from the vehicles or equipment would likely cause giant garter snake to move away from the area. The likelihood of mortality or injury is significantly reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving.

Indirect effects to giant garter snake from removal of trash or debris in rights-of-way may include latent mortality. Latent mortality could occur if giant garter snake die from injuries sustained during rights-of-way trash and debris removal. However, injury is unlikely because noise and vibration and noise may cause listed species to temporarily leave the area.

Removal of trash benefits listed species by reducing materials that could injure listed species and that also be potentially toxic. However, removal of trash may reduce temporary refugia used by snakes while on land.

42. SCADA System Repair and Upgrade

There would be no direct or indirect effects to listed fish species during SCADA system repair or upgrade activities because these tasks occur on land. Minor ground disturbance may occur and may affect giant garter snake if new or larger support panels are installed, although most panels are located in areas that do not provide habitat for giant garter snake. Therefore, SCADA system repair and upgrade activities are not likely to affect giant garter snake.

43. Sign Repair/Replacement/Installation.

Direct effects to listed fish species and giant garter snake from sign repair/replacement/ installation activities may include the following:

- Mortality of or injury to listed fish species or giant garter snake when boats are used.
- Reduction of the prey of listed fish species and giant garter snake.
- Mortality of giant garter snake from vehicle or equipment strike.

There could be mortality of or injury to giant garter snake or listed fish species during sign repair/replacement/installation activities. If boats must be used to repair, replace, or install signs, mortality or injury could occur if listed fish species or giant garter snakes are struck by the propeller. However, boat noise and disturbance of the water may cause listed fish species and giant garter snakes to avoid the area during this activity. CCWD will operate boats at slow speeds, which will allow fish and giant garter snake to flee the area. Reduction of prey of listed fish species and giant garter snake are short term, temporary and localized effects. Conditions are anticipated to return to ambient soon after work is completed. Vibration and noise from vehicles and heavy equipment may temporarily cause giant garter snake to leave the work area. The likelihood of giant garter snake mortality is reduced by strict adherence to the 15 mph speed limit and careful observation of the road while driving.

Indirect effects to listed fish species and giant garter snake may include latent mortality if listed fish species and giant garter snake are injured and later die.

44. Stilling Well Maintenance (pumping/backflushing etc.)

Direct effects to listed fish species and giant garter snake from stilling well maintenance activities may include the following:

- Mortality of or injury to listed species from increased turbidity.
- Mortality of or injury to giant garter snake from equipment and vehicle strikes.
- Prey of listed fish species and giant garter snake could be disturbed and leave the area.

Increased turbidity is anticipated during stilling well maintenance activities. Increased turbidity can make it difficult for listed fish species to locate prey, cause body abrasions, and clog fishes' gills. Studies have shown that suspended sediments can cause changes in respiration rates, choking, coughing, abrasion and puncturing of body structures, and reduced responses to physical stimuli (Anchor Environmental 2003). Wallen (1951 as cited in LFR 2004) reported that turbidity may cause excessive mucus secretion and excretory interference, and respiratory interference. Coarser particles in suspended sediments may harm fish by abrasion or by crushing if the particles are large enough (Everhart et al. 1970 as cited in LFR 2004). The effects of increased turbidity are temporary, localized, and short term. Ambient conditions are expected to return shortly after activities are completed. Therefore, mortality of or injury to listed fish species from increased turbidity is unlikely occur.

The RSFS 2/32-in. mesh prevents entrainment of winter-run Chinook salmon, spring-run Chinook salmon, steelhead, green sturgeon, and most juvenile and all adult longfin and delta smelts. Larval and post-larval longfin smelt and delta smelt could be susceptible to entrainment based on length, breadth, size of the head capsule, and how the larvae contact the screen. Once entrained, these larvae most likely do not survive to adulthood, due to the large numbers of non-native predatory fish still present in the Canal. If by chance survival occurred, later life stages of smelts would not able to migrate through the screen back to spawning grounds. Incidental take of entrained delta smelt and longfin smelt has been previously covered.

Mortality of or injury to giant garter snake could occur from contact with vehicles and equipment and increased turbidity. However, vibration and noise from equipment and vehicles could temporarily cause giant garter snake to leave the work area. The likelihood of mortality is significantly reduced. The effects of increased turbidity are temporary, localized, and short term. Ambient conditions are expected to return shortly after activities are completed. Therefore, mortality or injury is unlikely to occur.

Prey of listed fish species and giant garter snake could be disturbed and leave the area; however disturbance would be short term, temporary, and localized. Ambient conditions are anticipated to return soon after work is completed.

Indirect effects to listed fish species and giant garter snake may include latent mortality. Listed fish species and giant garter snake injured during stilling well maintenance could die of their injuries. However, noise and vibration may cause listed fish species and giant garter snake to leave the work area and thereby avoid injury.

48. Utility Trenching (SCADA/Power/Misc.)

Although there would be no direct or indirect effects to listed fish species during utility trenching, direct effects to giant garter snake from utility trenching may include the following:

- Mortality or injury from vehicle or equipment strikes or during trenching.
- Trenches can act as pitfall traps for giant garter snake.

Vehicle and equipment strikes may cause direct mortality to or injury of giant garter snakes. The likelihood of equipment strikes is low because vibration and noise from vehicles or equipment would likely cause giant garter snake to move away from the area. Trenches deeper than three feet with vertical walls can act as pitfall traps for giant garter snake and other wildlife. To avoid trapping giant garter snake, trenches should be covered or have at least one shallow sloped bank (i.e. at least 5 to 1 slope) to allow for an escape route for trapped wildlife. If work occurs during the inactive period, giant garter snake could also be taken if trenching occurs in areas where the snake is in hibernacula.

Indirect effects to giant garter snake from utility trenching may include the following:

- Latent mortality.
- Damaged or destroyed burrows could potentially reduce the abundance of overwintering refuge sites for giant garter snake.

Giant garter snake injured by vehicles, equipment, or during trenching could die of their injuries. However, noise and vibration may cause listed fish species and giant garter snake to leave the work area and thereby avoid injury. Destruction of ground squirrel burrows can reduce the abundance of winter dormancy refuge for giant garter snake, but this work is not likely to be constructed in ideal giant garter snake habitat and ground squirrels typically replace lost burrows quickly, making any disturbance even more temporary.

49. Wash and Paint Turnouts and Check Structures (includes Headworks/Flood Isolation and RSFS Structures)

Direct effects to listed species from washing and painting the Headworks/Flood Isolation/RSFS structures may include the following:

- Mortality of or injury to listed fish species and giant garter snake from propeller strikes, increased turbidity from pressure washing, and possible contamination of water through spillage of products.
- Temporary disturbance to listed fish species and giant garter snake prey.

Mortality or injury could occur to listed species during painting and washing of the upstream side of the fish screen if motorized boats are used and listed species are struck by propellers. However, CCWD will operate boats at slow speeds, which will allow fish and giant garter snake to flee the area. For work conducted at the Headworks or the Flood Isolation structures, no mortality of listed salmonids, green sturgeon, or later life stages of delta and longfin smelts is anticipated since these species/life stages no longer occur in the RSFS afterbay. Mortality of larval and post-larval delta and longfin smelts could occur if they are present during washing and painting activities. Incidental take of entrained delta smelt and longfin smelt has been previously covered. Mortality of or injury to giant garter snake could also occur from propeller strikes if work is conducted during the active period. Turbidity may be increased during pressure washing from wash water entering Rock Slough and the afterbay. Accidental spills of paints could contaminate waterways and affect listed species. CCWD will take precautions to ensure that paints are not spilled into the water or on land. Maintenance activities may also temporarily disturb the prey of listed fish species and giant garter snake. Because the maintenance activities are short term, localized, and temporary, ambient conditions are expected to return shortly after maintenance activities end.

Indirect effects to listed species from washing and painting the Headworks/Flood Isolation/RSFS structures may include latent mortality of listed species and its prey. Latent mortality could occur if listed fish species or giant garter snake are injured during washing and painting activities. Injury could increase the chance of infection and predation. The likelihood of latent mortality is reduced due to implementation of the measures described in Section 2.4.

50. Wash Bridges and Fish Screens

Direct effects to listed species from washing bridges and fish screens may include mortality of or injury to listed fish species and giant garter snake from contact with the screen, screen blanks, or replacement panels during removal or installation, from increased turbidity and contaminants, from increased predation, and from boat propeller strikes. Fish screen panels are removed for pressure washing and solid panels or replacement screens are put in place. Although unlikely, this action could result in a listed fish or giant garter snake being crushed as the panels or replacement screens are put in place. Disturbance of predatory fish near the RSFS may increase the chance of listed species being taken. However, noise and disturbance of water in the work area may cause all fish and giant garter snake to temporarily leave the area. For work conducted at the Headworks Structure, no mortality of listed salmonids, green sturgeon, or later life stages of delta and longfin smelts is anticipated since these species/life stages no longer occur in the RSFS afterbay. Mortality of larval and post-larval delta and longfin smelts could occur if they are present during bridge washing and fish screen cleaning activities.

Turbidity may be increased during pressure washing from wash water entering Rock Slough and the afterbay and could affect listed fish species by clogging their gills. However, screen panels will be washed on the deck, so no wash water is anticipated to enter Rock Slough. Listed fish species and giant garter snake could be affected by abrasion and by reduced foraging success. These maintenance activities are short term, localized, and temporary, and ambient conditions are expected to return shortly after maintenance activities end. Therefore, the likelihood of direct effects is low.

Indirect effects to listed species from washing bridges and fish screens may include latent mortality of listed species and latent effects to prey. Latent mortality could occur if listed fish species, giant garter snake, or their prey are injured during washing activities. Injury could increase the chance of infection and predation. Injury is unlikely because noise and disturbance of the water in the work area may cause listed fish species, giant garter snake, and their prey to temporarily leave the area.

53. Canal Desilting Operations

Direct effects to listed fish species and giant garter snake from Canal desilting activities may include the following:

- Mortality of or injury to listed species from entrainment into the suction and from increased turbidity.
- Mortality of or injury to giant garter snake from burying during placement of spoils.

Mortality of or injury to listed species could occur during desilting of the offshore RSFS concrete apron. Mortality could occur from entrainment of listed species into the suction device;

however, noise and water disturbance may cause listed species to avoid the area. Increased turbidity during desilting can clog gills, cause body abrasions, and make it difficult for fish and giant garter snake to locate prey. Studies have shown that suspended sediments can cause changes in fishes' respiration rates, choking, coughing, abrasion and puncturing of body structures, and reduced responses to physical stimuli (Anchor Environmental 2003). Wallen (1951 as cited in LFR 2004) reported that turbidity may cause excessive mucus secretion in fish and excretory interference, and respiratory interference. Studies have documented that many fish species, such as chum salmon, juvenile herring, and juvenile coho salmon, avoid areas that have increased turbidity (Nightingale and Simenstad 2001, Sigler 1990, Servizi 1990, Messieh et al. 1981 as cited in LFR 2004). Giant garter snake could be buried during placement of spoils. There are two strategies that could be used to decrease the likelihood of mortality of listed fish species and giant garter snake from desilting. Desilting of the concrete pad at the base of the RSFS and Headworks Structure would only be scheduled to occur based on the in-water work window for listed fish (August 1 through October 31) and the giant garter snake's active period (May 1 through October 1). Therefore, desilting will only occur during the narrowest window (May 1 through October 1). Desilting will be conducted at the beginning of a flood tide so that suspended sediments would flow through the screen and into the Canal. If there is a situation that threatens the integrity and operation of the RSFS, and desilting must occur outside of the May 1 through October 1 time period, a silt curtain may be deployed using the pilings offshore of the RSFS and the RSFS to hold the curtain in place. A silt curtain would contain the suspended sediments and also be effective at preventing entrainment and keeping listed species away from the work area. The effects of increased turbidity are short term, localized, and temporary, and ambient conditions are anticipated to return shortly after desilting activities cease.

Desilting activities occurring on the downstream side of the RSFS will not affect listed fish species if desilting occurs during the work window on a flood tide so that suspended sediments do not flow through the screen into Rock Slough. As previously discussed, no listed fish species other than larval and post-larval delta and longfin smelts are found in the afterbay and Canal.

Indirect effects of desilting include injury to fish and giant garter snake that could eventually result in death or a loss of listed species' prey. Fish and giant garter snake injured during desilting activities could die later from stress, infection, or they could be more susceptible to predation. There could be a loss or movement of prey from increased turbidity that could indirectly affect listed species. However, the effects of desilting are short term, localized, and temporary. Ambient conditions are anticipated to return soon after desilting is completed.

54. Minor Road Construction/Rehabilitation

Although there would be no affect to listed fish species from minor road construction/rehabilitation, direct effects to giant garter snake from these activities may include the following:

- Mortality or injury from vehicle or equipment strikes.
- Temporary disturbance to giant garter snake and prey species.

Equipment or vehicle strikes may cause mortality of or injury to giant garter snakes. The likelihood of equipment strikes is low because vibration and noise from vehicles or equipment would likely cause giant garter snake to move away from the area.

Indirect effects to giant garter snake from minor road construction/rehabilitation may include the following:

- Latent mortality of giant garter snake and its prey.
- Damaged or destroyed burrows may reduce abundance of overwintering refuge sites for giant garter snake.

Injured giant garter snake may suffer from latent mortality or reduced fitness due to vehicle strikes. Destruction of ground squirrel burrows can reduce the abundance of winter dormancy refuge for giant garter snake, but this work is not to be conducted in ideal giant garter snake habitat, and ground squirrels typically replace lost burrows quickly, making any disturbance temporary.

57. Structure Construction (Blockhouses, stilling wells etc.)

Although there would be no direct or indirect effects to listed fish species from structure construction activities, direct effects to giant garter snake from these activities may include mortality of or injury to giant garter snake. The likelihood of equipment strikes is low because vibration and noise from the equipment would likely cause giant garter snake to move away from the area. Giant garter snake could be affected by grading and pouring concrete pads. If construction occurs during the snake's inactive period, CCWD shall adhere to the measures listed in Section 2.4.

Indirect effects to giant garter snake from structure construction activities may include the following:

- Latent mortality of giant garter snake.
- Damaged or destroyed burrows may reduce abundance of overwintering refuge sites for giant garter snake.

Injured giant garter snake may suffer from latent mortality or reduced fitness due to vehicle or equipment strikes. This risk can be minimized by implementing the measures described in Section 2.4. Destruction of ground squirrel burrows can reduce the abundance of winter dormancy refuge for giant garter snake, but these structures are not likely to be constructed in ideal giant garter snake habitat, and ground squirrels typically replace lost burrows quickly, making any disturbance even more temporary.

58. Utility and Facilities Repair

There would be no direct or indirect effects to listed fish species from utility and facility repair activities as these would solely occur on land. Direct effects to giant garter snake from these activities may include the following:

- Mortality or injury from vehicle and equipment strikes.

- Temporary disturbance to giant garter snake and prey species.

Vehicle and equipment strikes may cause mortality to giant garter snakes. The likelihood of strikes is low because vibration and noise from vehicles and equipment would likely cause giant garter snake to move away from the area.

Indirect effects to giant garter snake from utility and facilities repair may include latent mortality. Injured giant garter snake may suffer from latent mortality or reduced fitness due to vehicle strikes. Again, this can be minimized by utilizing the measures described in Section 2.4.

5.2.4 Effects from Land Area Encroachment

There would be no effects to listed species if Reclamation elects to acquire approximately 10,000 square feet of property adjacent to lands associated with the RSFS Facility. This land would be treated and managed as lands for the Project, per the descriptions in this BA. Effects to listed species may occur from activities to reclaim the land should they be implemented. These effects would be minimized where applicable by implementing the measures described in Section 2.4.

5.2.5 Summary of Effects

Many of the Project activities described in this section have the potential to result in take of listed species; although, for many of the activities, the risk of take is low. Implementation of CCWD's minimization and avoidance measures (see Section 2.4) is intended to lower the risk of take. A summary of the direct and indirect effects, measures, and the effects determination for the Project is provided in Table 25.

Table 25 Summary of Potential Effects to Listed Species

Activity	Species	Potential Effects	Measures	Determination
Rake Improvements	LF	May benefit	None required	Not Likely to Adversely Affect LF
	GGS	DE=Mortality or injury from equipment/vehicle strikes IE=Latent mortality from injury	EAT; 15 mph speed limit	May adversely affect GGS
Debris Conveyance Improvements	LF, GGS	No effects	None required	Will not affect LF, GGS
Platform Extension	LF, GGS	DE=Minor shading may increase the attractiveness of the area to predatory fish and LF. LF and GGS could be taken	None proposed	May adversely affect LF, GGS
Boat Ramp Construction	LF, GGS	DE=Mortality or injury from in-water work; increased turbidity IE= Permanent loss of 0.02 acre of benthic habitat in RS and 0.02 acre RSFS afterbay; latent mortality	Construct during in-water work window; use of silt curtain	May adversely affect LF, GGS
	LF	DE=Permanent loss of 0.02 acre of delta smelt critical habitat in Rock Slough; reduction in prey from loss of benthic habitat	RSFS Project previously mitigated at Kimball Island Mitigation Bank (0.3 acres); 30.5 acres at Big Break shoreline	
	GGS	DE=Mortality or injury during land excavation; construction IE=Latent mortality	EAT; Pre-construction survey	
Log Boom Placement	LF, GGS	DE=Mortality or injury from boat	Slow boat speed;	May adversely affect

Activity	Species	Potential Effects	Measures	Determination
and Maintenance		propeller strikes IE=Latent mortality from injury	EAT	LF, GGS
	GGS	DE=Mortality or injury during installation of anchoring system; vehicle strikes IE=Latent mortality	EAT; Pre-construction survey	
Irrigation System Improvements	LF	DE=Mortality or injury from placement of pumps; propeller strikes; increased turbidity; installation of coffer dam and culvert in Extension IE=Latent mortality	Operate boat at slow speed	May adversely affect LF
	GGS	DE=Mortality or injury from equipment/vehicle/propeller strikes; burial when filling excavated area; increased turbidity IE=Latent mortality from injury	EAT; 15 mph speed limit; inspect excavated area prior to filling; conduct only during snake's active period	May adversely affect GGS
Land Area Encroachment Repairs	GGS	DE=Mortality or injury from equipment/vehicle strikes; excavation; filling; grading; restoration; fence work; increased turbidity during culvert and cofferdam work; temporary disturbance of prey IE=Latent mortality from injury	EAT; 15 mph speed limit; inspect excavated area prior to filling; conduct during snake's active period if possible; pre-construction surveys if work occurs during inactive period; mark and avoid burrows if possible	May adversely affect LF, GGS
	LF	Mortality or injury increased turbidity during culvert and coffer dam work	Construct during in-water work window; clear area of fish prior to coffer dam installation	
Site Access	LF, GGS	DE=increased turbidity from dust	EAT	May adversely affect LF,GGS
	GGS	DE= Mortality or injury from equipment/vehicle strikes; avoidance; temporary disturbances IE=Latent mortality from equipment/vehicle strikes	EAT; 15 mph speed limit; dust abatement	
Staging Areas & Parking	LF, GGS	DE=Mortality or injury from materials; fuels, lubricants, & solvents draining, spilling, or seeping into Rock Slough IE=Latent mortality	EAT; spill prevention measures; containment booms	May adversely affect LF, GGS
	GGS	DE=Mortality or injury from equipment/vehicle strikes; temporary disturbance IE=Latent mortality	EAT; adherence to speed limits; observing roads	
Installation of Fencing	GGS	DE=Mortality from equipment/vehicle strikes; temporary disturbance IE=Latent mortality from vehicle/equipment contact	EAT; adherence to speed limits; observing roads	May adversely affect GGS
	LF	No effects	None required	Will not affect
Operate Rakes	LF, GGS	DE=Mortality or injury from contact with the rake; entrapment; removal from Rock	Herbicides and mechanical harvesting to control aquatic weeds;	May adversely affect LF, GGS

Activity	Species	Potential Effects	Measures	Determination
		Slough; accidental release of hydraulic fluid; temporary disturbance IE=Latent mortality resulting from injury	testing of brush only mode; debris monitoring and operating according to tides; improvement of hydraulic fluid system	Beneficial to LF by keeping approach velocities low; reducing the chance for entanglement
Debris Management and Monitoring	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicle strikes; buried by debris IE=Latent mortality from vehicle strikes; buried by debris	15 mph speed limit; EAT	May adversely affect GGS
1. Aquatic Weed Contact Herbicide Application	LF, GGS	DE=Mortality through contact with boat propellers and herbicide exposure; mortality to prey species IE=Latent mortality from propeller strikes; herbicide exposure; reduction in DO concentrations from decomposing vegetation	Boat travel < 5 mph; conduct work if possible from June–October; herbicides applied at labeled rates by trained personnel; apply during incoming tides if possible; EAT; pre-application survey for GGS; notify CDBW to ensure they are not applying in area; use CCWD monitoring data and CDFW survey data to determine if listed smelts are in the area prior to applying in June or July	May adversely affect LF, GGS
2. Blading and Discing of Rights-of-Way	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicle/equipment or burial; loss of prey species habitat; loss of cover and refuge; temporary disturbance to GGS and prey species IE=Loss of habitat; loss of prey species; increased predation due to lack of cover; latent mortality from equipment strikes	EAT; pre-disturbance surveys if work occurs early Oct–April during inactive period; slow speeds for equipment/vehicles	May adversely affect GGS
3. Blading of O&M Roads	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from contact with blades & vehicles; temporary disturbance to GGS & prey species; burial of GGS w/in refugia IE=Latent mortality from contact with blades & vehicles; removal of suitable burrows	Pre-disturbance surveys if work occurs early Oct–April during inactive period; equipment speeds <15 mph; EAT	May adversely affect GGS
4. Canal Bank Revegetation	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from scarifying levee banks with heavy equipment IE=Damage or destruction of burrows; increased availability of	Revegetate with native, non-weedy species to counter loss of winter refugia; EAT	May adversely affect GGS; could benefit species

Activity	Species	Potential Effects	Measures	Determination
		habitat; increased prey species in revegetated areas		
5. Canal/Tunnel/ Conduit Liner Repair	LF	Work occurs downstream of RSFS; therefore only early life stages of delta and longfin smelts could be affected DE=Mortality of larval delta and longfin smelts	None proposed	No effect to salmonids, green sturgeon, and later life stages of listed smelts. May adversely affect larval smelts; incidental take is already covered for entrained delta and longfin smelts
	GGS	DE=Mortality or injury resulting from conducting repairs; disturbance to GGS during winter dormancy period IE=Latent mortality from injury due to conduit liner repairs	EAT	May adversely affect GGS
8. Contact Terrestrial Herbicide Applications	LF	DE=Mortality or injury if terrestrial herbicides enter the water from spills or runoff IE= Loss of habitat for prey species	Apply according to label; do not apply if rain is forecasted	May adversely affect LF
	GGS	DE=Mortality or injury of GGS from herbicide exposure; contact with vehicles or equipment IE=Loss of bank vegetation used for basking and cover; loss of habitat for prey species	Implement CCWD (IPMP) and Reclamation (Env. 01-01) procedures; Apply according to label; EAT	May adversely affect GGS
10. Canal Dewatering	LF	Work occurs downstream of RSFS; therefore only early life stages of delta and longfin smelts could be affected DE=Mortality of larval delta and longfin smelts	None required	No affect to salmonids, green sturgeon, and later life stages of smelts. May adversely affect larval smelts; incidental take is already covered for entrained delta and longfin smelts
	GGS	DE=Mortality or injury; temporary disturbance to GGS and prey species IE=Latent mortality; Individuals could be trapped/displaced from suitable habitat when depressions in canals refill during flooding	EAT; conduct survey if work occurs during active period (May 1–October 1); inspect prior to reflooding	May adversely affect GGS
11. Drain, Ditch, and Channel Maintenance	LF, GGS	DE=Mortality or injury from equipment/propeller strikes; reduction in LF and GGS prey as a result of increased noise and turbidity IE=Latent mortality from injury; reduction in prey species as a result of increased noise;	Maintenance to occur during work window if possible; EAT; 15 mph speed limit; slow boat speeds; pre-disturbance survey for GGS	May adversely affect LF, GGS. Beneficial effects from removal of trash and debris that may provide cover for predatory fish

Activity	Species	Potential Effects	Measures	Determination
		turbidity		
13. Hand and Mechanical Control of Vegetation	LF, GGS	DE=Mortality or injury from harvester strikes or entanglement in removed vegetation; mortality of aquatic prey species; temporary disturbances to LF, GGS, and prey species IE=Latent mortality of injured LF, GGS	Mechanically harvest between June 1-Oct 31; EAT; conduct surveys for GGS; remove log boom prior to mechanical harvesting; begin harvesting at Extension	May adversely affect LF, GGS
	GGS	DE= Mortality or injury from use of hand tools IE=Loss of GGS cover and foraging areas from removal of aquatic and bank edge vegetation		
14. Insecticidal Sprays	LF	DE=Mortality if insecticides enter the water from spills or runoff IE=Reduction of prey species	Implement CCWD (IPMP) and Reclamation's (Env 01-01) procedures; apply according to label; ensure no insecticides enter water	May adversely affect LF
	GGS	DE=Mortality to GGS through contact with toxic concentrations of insecticide; strikes by equipment IE=Reduction in prey species by elimination of lower trophic levels; bioaccumulation of toxins within food chain	Apply according to label; 15 mph speed limit; EAT	May adversely affect GGS
15. Mudjacking and/or Injecting Grout	LF	Work occurs downstream of RSFS; therefore only early life stages of delta and longfin smelts could be affected DE=Mortality of larval smelts	None required	No affect to salmonids, green sturgeon, and later life stages of smelts. May adversely affect larval smelts; incidental take already covered for entrained delta and longfin smelts
	GGS	DE=Mortality or injury of GGS from filling gaps in rip rap and filling burrows containing GGS; temporary disturbance to GGS and prey species IE=Removal of refuge areas under rip rap; removal of fossorial mammal burrows used as refugia	EAT; If work occurs during snake's inactive period (early October-April) conduct survey, mark fossorial mammal burrows and don't fill if possible	May adversely affect GGS
16. Pre-emergent Herbicide Applications	LF	DE=Mortality or injury if insecticides enter the water from spills or runoff IE= Loss of habitat for prey species	Implement CCWD (IPMP) and Reclamation's (ENV.01-01) procedures; do not apply if rain is forecasted	May adversely affect LF
	GGS	DE=Mortality or injury from vehicle or equipment strikes;	Apply herbicide according to label and	May adversely affect

Activity	Species	Potential Effects	Measures	Determination
		mortality from toxic herbicide concentrations IE=Latent mortality; loss of vegetation used as basking sites or for cover from predations; loss of prey species habitat	CCWD (IPMP) and Reclamation's (Env. 01-01) procedures; EAT; 15 mph speed limit; observe road while driving	GGS
18. Rights-of-Way Dust Abatement	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from contact with water trucks; temporary disturbance to GGS and prey species IE=Latent mortality	15 mph speed limit; EAT; observing road while driving	May adversely affect GGS
19. Rights-of-Way Mowing	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicle/equipment strikes; temporary disturbance from mowing equipment vibrations IE=Latent mortality	15 mph speed limit; EAT; observing the road while driving; if possible schedule mowing when GGS likely to be active	May adversely affect GGS
20. Rip Rap	LF, GGS	DE=Mortality or injury from being buried or struck by falling rip rap IE=Latent mortality; slight changes in water quality occurring over time depending on the type of rip rap installed and from increased particulate matter entering Rock Slough	None proposed	May adversely affect LF, GGS; incidental take already covered for entrained delta and longfin smelts
	GGS	DE=Mortality or injury from equipment; temporary disturbance to GGS and prey species IE=Loss of natural thermal mosaic; degradation and pollution of water; loss of fossorial mammal burrows used as winter dormancy	15 mph speed limit; EAT; observe road while driving	
22. Squirrel Baiting	LF	No effects	None required	Will not affect
	GGS	DE=None IE=Reductions in abundance of fossorial mammal burrows available for winter dormancy refuge.	Apply according to CCWD's IPMP	May adversely affect GGS
23. Bargate/Fence Installations	LF	No effect	None required	Will not affect
	GGS	DE=Mortality or injury if auger or backhoe damages or destroys occupied burrow; temporary disturbance to GGS and prey species IE=Latent mortality; potential reduction in available burrows for winter dormancy refuge	If possible conduct work during snake's active period (May 1-Oct 1); EAT; 15 mph speed limit; observe road while driving; pre-disturbance survey if work is done in the inactive period; mark fossorial mammal burrows and avoid if	May adversely affect GGS

Activity	Species	Potential Effects	Measures	Determination
			possible	
24. Bridge Maintenance (running pad replacement)	LF	DE=Mortality or injury from wash water and paint entering the Canal or Rock Slough; increased turbidity during removal and replacement of support pillars; increased sound from driving pillars; reduction or disturbance of LF species prey IE=Latent mortality; changes in water quality that could affect listed species over time	If possible, conduct removal and replacement of support pillars during August–October. If conducted outside of work window use silt curtain and work during incoming tide	May adversely affect LF, GGS
	GGS	DE=Mortality or injury from wash water and paint entering Rock Slough; increased turbidity lowering successful foraging within aquatic habitats; disturbance from vibration due to pillar driving; temporary disturbance to GGS and prey species IE=Latent mortality		
25. Cableway Maintenance (painting/cleaning/ repair)	LF, GGS	DE=Mortality or injury from lubricants and paints accidentally spilled offshore of RSFS IE=Latent mortality	Use best management practices to ensure no paints or lubricants are spilled into the water. Use containment booms in the unlikely event of a spill.	May adversely affect LF, GGS
29. Drainage Improvements (ditches or pipe)	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicle/equipment strikes if work is occurring adjacent to aquatic areas or if burrows are present in work area; trenches acting as pitfall traps if left open and have no escape ramps; earthwork can damage or destroy burrows used for refugia IE=Latent mortality from vehicle/equipment strikes; removal of burrows reduces availability of refugia	If possible, conduct work during the snake's active period; 15 mph speed limit; EAT; observing road while driving	May adversely affect GGS
30. Electrical Repairs by Utility Companies (PG&E, WAPA, or others)	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicle strikes; excavation can disturb or damage burrows and potentially harm occupants including GGS IE=Latent mortality	15 mph speed limit; observing road while driving	May adversely affect GGS
31. Embankment Maintenance	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicle or equipment strikes; mortality from collapsing	15 mph speed limit; EAT; observing road while driving; pre-disturbance	May adversely affect GGS

Activity	Species	Potential Effects	Measures	Determination
		burrows that are occupied by GGS during winter dormancy period; temporary disturbance to GGS and prey species IE=Latent mortality; damage to burrows can reduce overwintering refugia	survey; biological monitor on-site if required	
32. Facilities Inspection	LF, GGS	DE=Mortality or injury from propeller strikes, from vehicles (GGS); and disturbance of LF, GGS; and reduction in prey IE=Latent mortality	15 mph speed limit; EAT; observing road while driving; slow boat speeds	May adversely affect LF, GGS
33. Graffiti Removal from Concrete Structures	LF, GGS	DE=Mortality or injury from propeller strikes; increased turbidity from sandblasting; and possible contamination of water through spillage of products; temporary disturbance to LF species and GGS prey IE=Latent mortality of listed species and latent effects to prey	Slow boat speeds; use best management practices to ensure no paints or sand are spilled into the water	May adversely affect LF, GGS
34. Guardrail Installation/Repair	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicles or equipment; temporary disturbance to GGS and prey species IE=Latent mortality; potential for soil disturbance to damage or destroy burrows potentially used as refugia	15 mph speed limit; EAT; observing road while driving	May adversely affect GGS
35. Valve Rehabilitation	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicles or equipment; temporary disturbance to GGS and prey species IE=Latent mortality	15 mph speed limit; EAT; observing road while driving	May adversely affect GGS
36. Ladders/Safety Nets/Float/Log Boom Repair and Replacement	LF, GGS	DE=Mortality or injury from vehicles (GGS) and propeller strikes (LF and GGS); disturbing the water column could affect prey IE=Latent mortality	Pre-disturbance survey if repair/replacement activities occur during GGS active period; slow boat speeds	May adversely affect LF, GGS
37. Pull and Check Pumps	LF, GGS	No effects	None required	Will not affect
39. Instrument Recorder House Maintenance (door repair, painting, cleaning, etc.)	LF, GGS	No effects	None required	Will not affect
40. Removal of Trash or Debris	LF, GGS	DE= Mortality or injury from vehicles (GGS) and propeller strikes (LF and GGS);	15 mph speed limit; EAT; observing road while driving; slow boat speeds	May adversely affect LF, GGS Beneficial effects from

Activity	Species	Potential Effects	Measures	Determination
		temporary loss of prey IE=Latent mortality		removal of trash and debris that may provide cover for predatory fish. Debris could be toxic or injure fish and GGS
41. Rights-of-Way Trash Removal	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicles/equipment; temporary disturbance to GGS; prey species IE=Latent mortality	15 mph speed limit; EAT; observing road while driving	May adversely affect GGS
42. SCADA System Repair and Upgrade	LF, GGS	No effects	None required	Will not affect
43. Sign Repair/ Replacement/ Installation	LF, GGS	DE= Mortality or injury from propeller strikes; reduction of prey IE=Latent mortality	Slow boat speeds	May adversely affect LF, GGS
	GGS	DE=Mortality or injury from vehicles/equipment IE=Latent mortality	15 mph speed limit; EAT; observing road while driving	
44. Stilling Well Maintenance (pumping/ backflushing, etc.)	LF, GGS	DE= Mortality or injury from increased turbidity; disturbance of prey IE=Latent mortality	None proposed	May adversely affect LF, GGS
	GGS	DE=Mortality or injury from equipment/vehicles	15 mph speed limit; EAT; observe road while driving	
48. Utility Trenching (SCADA/Power/ Misc.)	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicles/equipment; trenches acting as pitfall traps IE=Damaged or destroyed burrows; latent mortality	15 mph speed limit; EAT; observing road while driving; cover trenches or have at least one shallow sloped bank for escape route	May adversely affect GGS
49. Wash and Paint Wash and Paint Turnouts and Check Structures (Includes Headworks/Flood Isolation and RSFSStructures	LF, GGS	DE=Mortality or injury from propeller strikes; increased turbidity from pressure washing; contamination of water through spillage; temporary disturbances IE=Latent mortality to listed species and latent effects to prey	Slow boat speeds; CCWD will take precautions to ensure paints are not spilled	May adversely affect LF, GGS
50. Wash Bridges and Fish Screens	LF, GGS	DE=Mortality for injury from contact with screen panels; screen blanks; or replacement panels during removal or installation; increased turbidity and contaminants; increased predation; and from boat propeller strikes IE=Latent mortality and latent	Slow boat speeds	May adversely affect LF, GGS

Activity	Species	Potential Effects	Measures	Determination
		effects to prey		
53. Canal Desilting Operations	LF, GGS	DE=Mortality from entrainment into suction; increased turbidity; IE=Latent mortality of injured LF, GGS, and prey	If possible, schedule desilting during in-water work window; silt curtain if desilting outside work window; desilt during flood tide if possible	May adversely affect LF, GGS
	GGS	DE=Mortality or injury during placement of spoils IE=Latent mortality	Observe area before placing spoils	May adversely affect GGS
54. Minor Road Construction/ Rehabilitation	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicles/equipment; temporary disturbance to GGS and prey species IE=Latent mortality of GGS and prey; damaged or destroyed burrows	15 mph speed limit; EAT; observing road while driving	May adversely affect GGS
57. Structure Construction (blockhouses, stilling wells, etc.)	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from equipment/vehicle strikes IE=Latent mortality; damaged or destroyed burrows	15 mph speed limit; EAT; observing road while driving; conduct pre-construction survey if during inactive period	May adversely affect GGS
58. Utility and Facilities Repair	LF	No effects	None required	Will not affect
	GGS	DE=Mortality or injury from vehicle/equipment strikes; temporary disturbance to GGS and prey IE=Latent mortality	15 mph speed limit; EAT; observing road while driving	May adversely affect GGS
Notes: LF=Listed Fish; GGS=Giant Garter Snake; DE=Direct Effects; IE=Indirect Effects; EAT=Environmental Awareness Training; IPMP= Integrated Pest Management Program.				

5.3 Effects to Federally Listed Species

This section discusses the potential for the Project activities impact categories described in the Proposed Action to result in effects to listed species. For each species, the potential for direct and indirect effects of the Project is assessed along with the potential impacts to each species' critical habitat and recovery, as applicable.

5.3.1 Sacramento River Winter-run Chinook Salmon

The direct and indirect effects to this species from Project activities were assessed in Section 5.2[13].

[13] No life stages of winter-run Chinook salmon are found downstream of the RSFS due to the 2/32-in mesh of the screen. Therefore, there will be no direct or indirect effects from Project activities that affect only the afterbay.

Effects to Critical Habitat and Recovery

Rock Slough and the surrounding sloughs (Dutch Slough and Sand Mound Slough) are not within designated critical habitat for Sacramento River winter-run Chinook salmon; therefore the Project will not affect its critical habitat.

The effects of Project activities will not appreciably reduce the likelihood of the recovery of Sacramento River winter-run Chinook salmon. The Project actions will neither reduce the reproduction, numbers, or distribution of the species (e.g., low likelihood of effects during Project activities).

Conclusion

Because Project activities may result in take, it was concluded that the Project may adversely affect Sacramento River winter-run Chinook salmon. Incidental take coverage is requested as described in Section 5.1. The activities will not impede the recovery of winter-run Chinook salmon, and critical habitat will not be affected.

5.3.2 Central Valley Spring-run Chinook Salmon ESU

The direct and indirect effects to this species from Project activities were assessed in Section 5.2.[14]

Effects to Critical Habitat and Recovery

Rock Slough and the surrounding sloughs (Dutch Slough and Sand Mound Slough) are not within designated critical habitat for Central Valley spring-run Chinook salmon; therefore the Project will not affect its critical habitat.

The effects of Project activities will not appreciably reduce the likelihood of the recovery of Central Valley spring-run Chinook salmon. The Project actions will neither reduce the reproduction, numbers, or distribution of the species.

Conclusion

Because Project activities may result in take, it was concluded that the Project may adversely affect Central Valley spring-run Chinook salmon. Incidental take coverage is requested as described in Section 5.1. The activities will not impede the recovery of spring-run Chinook salmon, and critical habitat will not be affected.

5.3.3 Central Valley Steelhead DPS

The direct and indirect effects to this species from Project activities were assessed in Section 5.2.[15]

Effects to Critical Habitat and Recovery

Critical habitat for Central Valley steelhead in Rock Slough begins where Sand Mound Slough joins Rock Slough and continues east to Old River. Sand Mound Slough and Dutch Slough are within designated critical habitat for Central Valley steelhead; however, no direct or indirect

[14] No life stages of spring-run Chinook salmon are found downstream of the RSFS due to the 2/32-in mesh of the screen. Therefore, there will be no direct or indirect effects from Project activities that affect only the afterbay.

[15] No life stages of Central Valley steelhead are found downstream of the RSFS due to the 2/32-in mesh of the screen. Therefore, there will be no direct or indirect effects from Project activities that affect only the afterbay.

effects from herbicide application or other Project components are anticipated to occur in Sand Mound or Dutch sloughs. Therefore, Central Valley steelhead critical habitat will not be affected by Project activities.

The effects of Project activities will not appreciably reduce the likelihood of the recovery of Central Valley steelhead. The actions will neither reduce the reproduction, numbers, or distribution of the species, nor will they appreciably diminish the value of the critical habitat (e.g., no blockage of migration, no permanent or temporary loss of critical habitat).

Conclusion

Because Project activities may result in take, it was concluded that the Project may adversely affect Central Valley steelhead. Incidental take coverage is requested as described in Section 5.1. The activities will not impede the recovery of steelhead, and critical habitat will not be affected.

5.3.4 Southern DPS of North American Green Sturgeon

The direct and indirect effects to this species from Project activities were assessed in Section 5.2.

Effects to Critical Habitat and Recovery

Rock Slough is not within designated critical habitat for green sturgeon. No Project activities will have direct or indirect effects outside of Rock Slough, and therefore, critical habitat will not be affected.

The effects of the Project will not appreciably reduce the likelihood of the recovery of the southern DPS of green sturgeon. The Project will not block access to spawning habitat, nor will it affect hydrographic or water temperatures below Keswick and Oroville dams. The Project has no effect on the green sturgeon fishery nor does it involve entrainment or impingement of green sturgeon. The minimal loss to a small portion of benthic habitat that is available to green sturgeon (approximately 1,400 square feet [0.02 acre]) is unlikely to impede recovery of green sturgeon.

Conclusion

Because Project activities may result in take, it was concluded that the Project may adversely affect green sturgeon. Incidental take coverage is requested as described in Section 5.1. The activities will not impede the recovery of green sturgeon, and critical habitat will not be affected.

5.3.5 Delta Smelt

The direct and indirect effects from Project activities were assessed to determine impacts to delta smelt.

Effects to Critical Habitat and Recovery

All of Rock Slough falls within designated critical habitat for delta smelt. As described in Section 3.2.5, there are four PCEs for delta smelt critical habitat, none of which will be significantly affected by the proposed Project, as discussed below.

1. **Spawning Habitat** — Delta smelt adults seek shallow, fresh, or slightly brackish backwater sloughs and edgewaters for spawning. To ensure egg hatching and larval

viability, spawning areas also must provide suitable water quality (i.e. low concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emergent vegetation). Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay. The spawning season varies from year to year and may start as early as December and extend until July.

Rock Slough and the surrounding sloughs (Dutch Slough and Sand Mound Slough) are not ideal locations for spawning delta smelt. The shorelines of the sloughs have been straightened and rip rapped and generally do not possess the appropriate substrate for egg attachment. Untreated agricultural drainage water currently enters both Sand Mound Slough and Dutch Slough. Additionally, the presence of Brazilian elodea and other invasive aquatic weeds provide habitat for predators such as largemouth bass and striped bass. Therefore, the effects to spawning habitat are insignificant.

2. **Larval and Juvenile Transport** — To ensure that delta smelt larvae are transported from the area where they are hatched to shallow, productive rearing or nursery habitat, the Sacramento and San Joaquin Rivers and their tributary channels must be protected from physical disturbance (e.g., sand and gravel mining, diking, dredging, and levee or bank protection and maintenance) and flow disruption (e.g., water diversions that result in entrainment and in-channel barriers or tidal gates). Adequate river flow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay. Additionally, river flow must be adequate to prevent interception of larval transport by the State and Federal water projects and smaller agricultural diversions in the Delta. To ensure that suitable rearing habitat is available in Suisun Bay, the 2 ppt isohaline must be located westward of the Sacramento-San Joaquin River confluence during the period when larvae or juveniles are being transported, according to the historical salinity conditions which vary according to water-year type.

The Project will not adversely affect larval and juvenile transport. The Project activities will not affect river flow that is necessary to transport larvae to Suisun Bay. The activities of the Project will not affect the location of the 2 ppt isohaline.

3. **Rearing Habitat** — Maintenance of the 2 ppt isohaline according to the historical salinity conditions described above and suitable water quality (low concentrations of pollutants) within the Estuary is necessary to provide delta smelt larvae and juveniles a shallow, protective, food-rich environment in which to mature to adulthood. This placement of the 2 ppt isohaline also serves to protect larval, juvenile, and adult delta smelt from entrainment in the State and Federal water projects. An area extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat. Three Mile Slough represents the approximate location of the most upstream extent of tidal excursion when the historical salinity conditions described above are implemented.

Protection of rearing habitat conditions may be required from the beginning of February through summer.

The activities of the Project will not adversely affect the hydrology of the Delta or have any impact on the 2 ppt isohaline.

4. **Adult Migration** — Adult delta smelt must be provided unrestricted access to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries, including Cache and Montezuma sloughs and their tributaries. These areas also should be protected from physical disturbance and flow disruption during migratory periods.

The Project activities will not adversely affect the hydrology of the Delta.

None of the PCEs for the delta smelt's critical habitat will be significantly affected by the Project. The permanent loss of approximately 1,400 square feet (0.02 acre) that is of marginal quality for delta smelt, is discountable because the effects on delta smelt could not be meaningfully measured or detected.

Project activities will not appreciably reduce the likelihood of the recovery of delta smelt. Project activities will neither appreciably reduce the reproduction, numbers, or distribution of the species, as indicated by CCWD monitoring data showing low numbers of juvenile or adult delta smelt (n=1) and low numbers of larval delta smelt (n=1) in the Project area vicinity[16].

Conclusion

Because Project activities may result in take, it was concluded that the Project may adversely affect delta smelt. The activities will not impede the recovery of delta smelt. There will be a permanent loss of a small area (approximately 0.02 acre) of benthic habitat, which is within designated critical habitat, as a result of the proposed Rock Slough boat ramp. The effect of the minimal loss of marginal habitat on delta smelt is not likely to be adverse, and is discountable because the effects on delta smelt could not be meaningfully measured or detected. Incidental take of entrained delta smelt was previously covered by USFWS for some project actions. Because take of delta smelt may occur from Project activities, take coverage is requested as described in Section 5.1.

5.3.6 Longfin Smelt

The direct and indirect effects to this species from Project activities were assessed in Section 5.2 because USFWS determined that listing is warranted.

Effects to Habitat and Recovery

Longfin smelt are currently being considered for listing under the federal ESA. USFWS determined that longfin smelt warrant listing. USFWS will develop a proposed rule to list longfin smelt as their priorities allow (USFWS 2012). There is no designated critical habitat, nor has any recovery plan been issued. The effects of the Project will not appreciably reduce the

[16] One larval delta smelt was collected downstream of the RSFS in 2012.

likelihood of the recovery of longfin smelt. Overall, the Project activities will neither appreciably reduce the reproduction, numbers or distribution of the species, nor will they appreciably diminish the value of the habitat (no blockage of migration and transport). As discussed in Section 5.3.5, the permanent loss of approximately 1,400 square feet (0.02 acre) of benthic habitat in Rock Slough is not likely to significantly affect longfin smelt.

While there is no federal recovery plan, CDFW has considered seven actions that would have population level benefits (CDFG 2009). The Project will contribute to those actions as follows:

- Reduce pollution of estuaries by chemicals harmful to longfin smelt and their food web.

The herbicides proposed for use, when applied at labeled rates, are not likely to adversely affect longfin smelt. Removing the aquatic vegetation provides benefits longfin smelt by increasing DO levels, increasing turbidity, reducing shading, and reducing cover for predators.

- Reduce entrainment and loss of longfin smelt at water diversions–including diversions for cooling of power plants and diversions operated by the State Water Project, Central Valley Project, municipal entities, and for agricultural and recreational purposes. For example, moving the SWP and CVP diversions from the south Sacramento-San Joaquin Delta would reduce loss of longfin smelt to entrainment.

The Project activities do not affect entrainment.

- Reduce entrainment and loss of adult, juvenile, and larval longfin smelt to dredging.

Desilting activities would be scheduled to occur during the in-water work window of August 1 through October 31 when longfin smelt are not likely to be in the vicinity. However, there may be emergency situations that occur that would require desilting outside of the work window. If longfin smelt are present, they could be entrained by the suction.

- Reduce predation on longfin smelt by managed non-natives fish.

Currently the habitat within the sloughs favor non-native predatory fish. The water is relatively clear due to the presence of the Brazilian elodea and other invasive aquatic vegetation which also provide cover for predatory fish. Removal of the aquatic vegetation may reduce predation of longfin smelt.

- Improve and/or expand habitat for longfin smelt. For example, this could include increasing average December–May Sacramento-San Joaquin Delta outflow, restoring intertidal or shallow subtidal habitat, and/or improving habitat in the floodplain or in open water.

Longfin smelt habitat will be improved by removing the invasive aquatic vegetation that can lower DO levels, increase water clarity, slow movement of water, and provide shading that can affect lower trophic levels.

Conclusion

If USFWS lists longfin smelt, Reclamation requests that coverage be provided to the extent permitted under this biological assessment and consultation. Because Project activities may result in take of longfin smelt, it was concluded that the Project may adversely affect longfin smelt. The Project activities will not impede the recovery of longfin smelt. There will be a permanent loss of a small area (approximately 0.02 acre) of benthic habitat as a result of the proposed Rock Slough boat ramp. The minimal loss of habitat on longfin smelt is not likely to be adverse, and is discountable because the effects on longfin smelt could not be meaningfully measured or detected.

5.3.7 Giant Garter Snake

The direct and indirect effects to this species from Project activities were assessed in Section 5.2.

Effects to Habitat and Recovery

No critical habitat has been designated for the giant garter snake. The irrigation ditches and canals within and adjacent to the Project area are considered habitat for giant garter snake; however, the species is not abundant in the area. Upland grasslands with fossorial mammal burrows adjacent to the waterways within and adjacent to the Project area provide potential dormancy sites for aestivating snakes.

The effects of the Project will not appreciably reduce the likelihood of the recovery of giant garter snake. Overall, the Project activities will neither appreciably reduce the reproduction, numbers or distribution of the species, nor will they appreciably diminish the value of the habitat. The permanent loss of approximately 1,400 square feet (0.02 acre) of benthic habitat is not likely to significantly affect giant garter snake.

The activities proposed for the Project area will not appreciably contribute or depreciate from the six general recovery action items listed in Section 3.2.7. Any improvement to habitat is potentially beneficial to the continued survival of giant garter snake; however, being marginal habitat to begin with, and located such a great distance from known established populations of giant garter snake, the Project is not likely to have a negative or beneficial effect on overall giant garter snake recovery efforts.

Conclusion

Because Project activities may result in take, it was concluded that the Project may adversely affect giant garter snake. Incidental take coverage is requested as described in Section 5.1. The activities will neither impede nor appreciably contribute to its recovery.

Section 6 Cumulative Effects

Cumulative effects are effects resulting from future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation. Future Federal actions unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Cumulative effects may occur from continued agricultural operations in the Delta and beyond, as well as urbanization, which together contribute to lowered water quality from pesticide and fertilizer runoff and input of waste materials passing through water treatment facilities (e.g., antibiotics and other pharmaceutical products found in human waste).

Continued trade, commerce, and recreation among regions and also globally are likely to continue to introduce exotic invasive species to the Delta. The impact of these new species is uncertain, although past experience suggests that the quality of the environment for native species is unlikely to be favored as a result. Pelagic organisms have been greatly affected by a myriad of impacts related to water chemistry, pollutants, and invasive species, often which have arrived through anthropogenic assistance. The effects to this part of the Delta community can be widespread, but impacts to some listed species or life stages may be affected by changes in the food web and broader ecosystem.

Planned development in the vicinity of Rock Slough is likely to continue to degrade and reduce upland habitat that may be utilized by giant garter snake. The impact of this to the species is expected to be minor, however, because populations of giant garter snake are believed to be low in the Action area. As such, cumulative effects would not contribute significantly to effects to giant garter snake. Additionally, because the development would occur in uplands and stormwater runoff would be captured and treated appropriately, cumulative effects would not contribute significantly to effects to listed fish species.

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Appendix A

Essential Fish Habitat Assessment

ESSENTIAL FISH HABITAT ASSESSMENT

The Action Area (Section 2.3 of the Biological Assessment [BA]) for the Rock Slough Fish Screen (RSFS) Facility Improvement Project (Project) contains Essential Fish Habitat (EFH) for Chinook salmon (*Oncorhynchus tshawytscha*[1]) which are covered under the Pacific Coast Salmon Fish Management Plan (PFMC 1999). Therefore, the Bureau of Reclamation (Reclamation) has prepared this EFH assessment to address the Project's impacts on the EFH of Chinook salmon.

A.1 Description of the Project/Proposed Activity

The Project contains the following main components as described in Section 2.2 of the BA: (1) improvements to the RSFS as well as various site improvements/adjustments; (2) administrative actions such as the transfer of Operation and Maintenance (O&M) from Reclamation to Contra Costa Water District (CCWD), land acquisition, and/or the issuance of land use authorizations; and (3) O&M of the RSFS and associated appurtenances.

The proposed RSFS improvements are designed to address mechanical failures, hydraulic fluid releases, excessive maintenance, and other deficiencies and to allow RSFS to be operated more safely, effectively, and efficiently.

A.2 Setting and Background Studies

A.2.1 Aquatic Habitat in the Vicinity of the Proposed Project

The Project is located in the northeastern-most portion of the San Francisco Bay-Delta Estuary in the Sacramento-San Joaquin Delta. The principal water bodies near the Project Area include Rock Slough, Dutch Slough, and Sandmound Slough. Big Break, a large embayment formed when a reclaimed and subsided agricultural "island" flooded after a levee failure in 1928, is located north of the Project Area and provides connectivity to the San Joaquin River. All of these water bodies are tidally influenced.

The in-water components of the project are located within Rock Slough at a location nine river miles (through Big Break, Dutch Slough, Sandmound Slough, and Rock Slough) from the San Joaquin River. Rock Slough is a tidally influenced dead-end slough. The water depth in the center of Rock Slough is approximately 10 feet mean high water (MHW). The aquatic habitat in the vicinity of the proposed Project is representative of the estuarine transition zone, where freshwater from the Delta mixes with saline water from estuarine bays to the west. This freshwater to low salinity estuarine habitat provides EFH for Chinook salmon.

The habitat value in the area of the Project is considered greatly reduced from historic conditions. Once supporting a healthy aquatic ecosystem, the area (central Delta) is now defined by low salinity water, invasive aquatic plants (e.g., Brazilian elodea, water hyacinth), and

[1] Includes Sacramento River winter-run and Central Valley spring-run, fall-run, and late fall-run.

increased numbers of non-native predators, including largemouth bass and striped bass. The increase in the abundance of largemouth bass, as shown by the salvage data at the Central Valley Project (CVP) and State Water Project (SWP) pumps, occurred at the same time as the increase in the range of the invasive submerged macrophyte Brazilian elodea (Brown and Michniuk 2007). Additionally, the central Delta (and portions of the south Delta) has warmer water and higher water clarity. Water temperatures measured in Rock Slough from, 2013 through 2015 are shown in Figure 23 in the BA.

A detailed account of the environmental setting for the Project is presented in Section 3.1 of the BA.

A.2.2 Information on the Presence of Species with Designated EFH

CCWD has implemented a fish monitoring program at Rock Slough since 1999. Sieve net sampling was conducted at the Headworks Structure from 1999–2009 by deploying a 1,600-micron mesh net for a period of three hours per survey. During the sensitive fish season (January through June), typically three surveys were conducted each week. During the remainder of the year (July through December), generally one survey was conducted each week. Over 500 sieve net samples were collected from 2003–2009; there are no records of the number of surveys conducted prior to 2003.

Eleven years of CCWD's fish monitoring sieve net data (1999–2009) was reviewed in order to document the presence of Chinook salmon near the proposed Project. A total of 8,681 fishes was collected during this time period. Results showed that 96% of the total number of fishes collected were introduced species (see Table 12 in BA). Non-native predatory fishes (bluegill, largemouth bass, striped bass, redear sunfish, and white catfish) comprised approximately 56% of the total number of fishes collected during the 11-year study. Chinook salmon comprised approximately 0.4% of the total number of fishes collected during the 11-year study. Thirty-two Chinook salmon were collected at the Headworks Structure during the years analyzed. Of the 32 Chinook salmon collected, 18 were Central Valley fall-run, 11 were Central Valley spring-run, and run categories were not able to be determined for three individuals (Table A-1). No winter-run Chinook salmon were collected during the 11-year study. No Chinook salmon were collected during the in-water work window (August 1 – October 31).

Table A-1. A summary of Chinook salmon collected during CCWD's Rock Slough Headworks Fish Monitoring Program from 1999 through 2009 prior to construction of the RSFS.

Run	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Fall-run	0	0	0	0	0	5	10	1	0	2	0	**18**
Spring-run	0	0	0	0	0	3	4	3	0	1	0	**11**
Undetermined*	0	3	0	0	0	0	0	0	0	0	0	**3**
Total	**0**	**3**	**0**	**0**	**0**	**8**	**14**	**4**	**0**	**3**	**0**	**32**

*Length information was not provided, so the run category could not be determined.

In Fall 2011, a positive barrier fish screen was completed at the Rock Slough intake. The fish screen is equipped with a screen cleaning system consisting of four buckets with attached rakes. The screen system can be operated manually or automatically to scrape debris from the intake screens onto a conveyor belt emptying into debris pits for disposal. Beginning on November 15, 2011, adult fall-run Chinook salmon began appearing in the debris pits at the RSFS. An investigation into the collection of salmon by the screen cleaning system was initiated. All salmon captured by the screen cleaning system were recovered from the debris pits. Biological data for each specimen (length, weight, condition, sex, and presence/absence of adipose fin) were collected, and fin-clipped specimens were transported to U.S. Fish and Wildlife Service in Stockton for coded wire tag reading (used to determine hatchery information).

Thirty-nine Chinook salmon were recovered from the RSFS debris pits from November 15, 2011 through December 3, 2012 (Table A-2). Of the 39 Chinook salmon captured, 25 individuals had their adipose fins clipped, indicating they were reared in hatcheries. Most hatchery-reared Chinook salmon are implanted with coded wire tags, which link an individual to information such as the hatchery of origin, brood year, release date, and release location. Based on the reading of coded wire tags, all the recovered hatchery-reared fish were fall-run Chinook salmon. The remaining 14 specimens were not fin-clipped, but all fell within the size range of the hatchery-reared fish. Twenty-one of the fin-clipped Chinook salmon were from the Mokelumne fish hatchery, one was from the Nimbus fish hatchery, and three were from the Merced River fish hatchery. Release dates of the hatchery fish ranged from June 2007 through June 2010. Release locations included Sherman Island, Jersey Point on the San Joaquin River, San Pablo Bay, and Mare Island. Thirty-eight of the 39 Chinook salmon were able to be sexed (15 females, 23 males); one specimen was too damaged for sex to be determined. The fork length of Chinook salmon ranged from 21.0 in. (533 mm) to 34.0 in. (864 mm) with a mean of 25.9 in. (658 mm). The weight of Chinook salmon ranged from 2.4 lb (1.1 kg) to 15.4 lb (7.0 kg) with a mean of 6.6 lb (3.0 kg) (Table A-2).

Monitoring of the debris pits continued through 2015. No salmon were collected by the rakes in 2013–2014. On November 10, 2015 a single Chinook salmon was recovered from the RSFS's eastern debris pit. It did not have an adipose fin, indicating it was raised in a hatchery. The head was examined for a coded wire tag, but none was found. The salmon was male, had a total length of 24.8 in. (630 mm), a fork length of 24 in. (610 mm), a standard length of 22.4 in. (570 mm), and weighed 4 lb (1.8 kg). The specimen was assumed to be a fall-run based on its size and the time of year it was collected.

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Table A-2. Summary of Chinook salmon recovered from the debris pits at the RSFS 2011-2015.

Run	Sex	Date Collected	FL (mm)	FL (in.)	Weight (lb)	Fin Clipped?	Hatchery	Brood Year	Release Date	Release Location
N/A	Female	11/15/2011	554	21.8	4.0	No	N/A	N/A	N/A	N/A
Fall	Male	11/17/2011	574	22.6	4.0	Yes	Mokelumne	2009	6/1/2010	Sherman Island
Fall	Male	11/21/2011	640	25.2	6.3	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Female	11/21/2011	826	32.5	13	Yes	Mokelumne	2008	5/15/2009	Sherman Island
N/A*	Female	11/22/2011	620	24.4	6.5	Yes	N/A*	N/A*	N/A*	N/A*
Fall	Female	11/22/2011	622	24.5	6.8	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Male	11/23/2011	574	22.6	4.3	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
N/A	Female	11/23/2011	602	23.7	5.5	No	N/A	N/A	N/A	N/A
N/A*	Male	11/25/2011	693	27.3	8.8	Yes	N/A*	N/A*	N/A*	N/A*
Fall	Female	11/28/2011	635	25	4.5	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Male	11/28/2011	617	24.3	6.0	Yes	Merced	2009	5/26/2010	Jersey Point,
N/A	Male	11/28/2011	654	25.8	6.3	No	N/A	N/A	N/A	N/A
Fall	Male	11/29/2011	629	24.8	6.3	Yes	Mokelumne	2009	6/1/2010	Sherman Island
Fall	Female	11/29/2011	832	32.8	15	Yes	Nimbus	2009	6/8/2010	Mare Island
N/A	N/A	11/29/2011	617	24.3	N/A	No	N/A	N/A	N/A	N/A
Fall	Male	11/29/2011	660	26	3.5	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Male	11/30/2011	565	22.3	4.3	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Male	11/30/2011	686	27	7.5	Yes	Mokelumne	2009	4/21/2010	Sherman Island
N/A	Female	12/1/2011	585	23	6.0	No	N/A	N/A	N/A	N/A
Fall	Female	12/1/2011	607	23.9	6.8	Yes	Mokelumne	2009	4/21-22/2010	Sherman Island
Fall	Male	12/1/2011	587	23.1	5.3	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Male	12/1/2011	730	28.8	8.5	Yes	Merced	2009	5/26/2010	Jersey Point
Fall	Male	12/1/2011	559	22	4.0	Yes	Mokelumne	2009	6/1/2010	Sherman Island
N/A*	Female	12/2/2011	800	31.5	14	Yes	N/A*	N/A*	N/A*	N/A*
N/A	Male	12/2/2011	622	24.5	6.0	No	N/A	N/A	N/A	N/A
Fall	Male	12/2/2011	635	25	6	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Female	12/2/2011	816	32.1	13	Yes	Mokelumne	2008	6/8/2010	Sherman Island
Fall	Male	12/2/2011	660	26	6.8	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Male	12/2/2011	638	25.1	6	Yes	Mokelumne	2009	6/1/2010	Sherman Island
Fall	Male	12/2/2011	533	21	3.8	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Female	12/2/2011	702	27.6	3.8	Yes	Merced	2009	5/26/2010	Jersey Point
Fall	Male	12/2/2011	616	24.3	2.5	Yes	Mokelumne	2009	6/1/2010	Sherman Island
Fall	Female	12/2/2011	641	25.3	3	Yes	Mokelumne	2009	6/1-4/2010	Sherman Island
Fall	Male	12/14/2011	607	23.9	2.8	Yes	Mokelumne	2009	6/1/2010	Sherman Island
N/A	Male	12/19/2011	660	26	2.4	No	N/A	N/A	N/A	N/A
Fall	Male	1/16/2012	838	33	13	Yes	Mokelumne	2007	6/11-12/2007	San Pablo Bay
N/A	Female	1/31/2012	864	34	15.4	No	N/A	N/A	N/A	N/A
N/A	Male	11/19/2012	556	21.9	2.4	No	N/A	N/A	N/A	N/A

Run	Sex	Date Collected	FL (mm)	FL (in.)	Weight (lb)	Fin Clipped?	Hatchery	Brood Year	Release Date	Release Location
N/A	Female	12/3/2012	749	29.5	5.6	Yes	N/A*	N/A*	N/A*	N/A*
Fall	Male	11/10/2015	610	24.0	4.0	Yes	N/A*	N/A*	N/A*	N/A*

*Although specimen was fin clipped, no coded wire tag was found.

A.3 Chinook Salmon Essential Fish Habitat and Life History

The runs of Chinook salmon managed under the Pacific Coast Salmon Fish Management Plan (FMP) that may occur within the Action Area are listed in Table A-3. This species could occur in the Action Area for some portion of its life history.

Table A-3. Managed fish species, including life stages, with EFH identified within the Project Action Area.

Common Name	Scientific Name	Eggs/ Larvae	Juvenile/ Sub-adult	Adult	Spawning
Pacific Coast Salmon FMP					
Sacramento River winter-run Chinook (ESA listed)	*O. tshawytscha*		X	X	
Central Valley spring-run Chinook (ESA listed)	*O.tshawytscha*		X	X	
Central Valley fall/late fall-run Chinook (EFH only)	*O.tshawytscha*	*	X	X	

X denotes life stage occurring within the Action Area.
* A portion of the fall-run fry population emigrates soon after emergence.

The EFH for managed species, including Habitat Areas of Particular Concern (HAPC), are set forth in the Pacific Coast Salmon FMP prepared by the Pacific Fishery Management Council (PFMC). This section provides a description of Chinook salmon EFH as defined in the FMP, and the life history and species occurrence information from past and recent studies.

A.3.1 Pacific Coast Salmon FMP

The PFMC manages the fisheries for coho, Chinook, and pink salmon. Amendment 14 of the Pacific Coast Salmon FMP (PFMC 1999) provides that the EFH for Pacific Coast salmon includes freshwater, estuarine, and ocean habitats as well as terrestrial areas where an activity may result in impacts to aquatic EFH. EFH includes all those streams, lakes, ponds, wetlands, and other currently viable water bodies as well as most of the habitat historically accessible to salmon. Salmon EFH excludes areas upstream of longstanding naturally impassible barriers (i.e., natural waterfalls in existence for several hundred years), but includes aquatic areas above all artificial barriers except specifically named impassible dams. Salmon EFH extends from environments within state territorial waters out to the full extent of the Exclusive Economic Zone (EEZ) offshore of Washington, Oregon, and California north of Point Conception. Only Chinook salmon EFH is applicable to the Project.

In estuarine areas, Chinook salmon EFH includes nearshore and tidal submerged environments. Freshwater EFH for Chinook salmon consists of four major habitat functions: 1) spawning and incubation, 2) juvenile rearing, 3) juvenile migration corridors, and 4) adult migration corridors and holding habitat. Freshwater EFH in the vicinity of the Project for Chinook salmon includes three of the four major habitat functions (juvenile rearing, juvenile migration corridors, and adult holding habitat); spawning and incubation occur far upstream of the Project.

Four runs of Chinook salmon could occur in the vicinity of the Project Area at various times of the year: Sacramento River winter-run, Central Valley spring-run, fall-run, and late fall-run. Sacramento River winter-run and Central Valley spring-run eggs and fry do not occur in the vicinity of the Project. In the Bay-Delta, offshore of the Project, juvenile Sacramento River winter-run Chinook salmon can be present from November–May, while migrating adults can occur from November–June (NMFS 1997). In general, adult Central Valley spring-run Chinook salmon migrate upstream to spawn from March–September with peak migration in May–June (Moyle 2002). Most spring-run juveniles move downstream in the first high flows of winter in November–January, although some may persist through March (USFWS 1996). In the Sacramento River, most spring-run downstream movement occurs in December–February (Vogel and Marine 1991). Spring-run out-migrants may spend some time in the Sacramento River or Estuary to gain additional size before smolting and going out to sea, but most have presumably left the stream system by mid-May. Fall/late fall-run eggs do not occur in the Project Area. Three life stages (fry, juveniles, and adults) of fall/late fall-run Chinook salmon can be present in the vicinity of the Project at various times. A portion of the fall-run fry population (length-40 to 50 mm [1.57 to 1.97 in.]) migrates downstream soon after emergence where they rear in the lower Delta river channels and Suisun Bay during the spring. These fall-run fry enter the Estuary in January and peak in abundance in February and March. Juvenile fall-run Chinook salmon (length-80 to 90 mm [3.15 to 3.54 in.] long) can occur from Apri1–early June and adult fall-run Chinook salmon are in the vicinity of the Project during late summer and fall (approximately late June–early December). Late fall-run juveniles can be in the vicinity of the Project from April–June and adults migrate from October–April.

A.3.2 Life History

Detailed life history information for Sacramento River winter-run and Central Valley spring-run Chinook salmon is provided in Sections 3.2.1 and 3.2.2 of the BA, respectively. Life history information for Central Valley fall/late fall-run is provided below.

The Central Valley fall-run ESU includes fall-run and late fall-run Chinook salmon in the Sacramento and San Joaquin rivers and their tributaries. The fall/late fall-run was historically the most abundant salmon run in the Central Valley. Fall-run and late fall-run Chinook salmon are currently Federal and State Species of Concern, but are not listed for protection under either the Endangered Species Act (ESA) or California ESA. In 1998, NMFS proposed that Central Valley fall-run and late fall-run Chinook salmon be listed under the ESA as a threatened species. Based on further analysis and public comment, NMFS determined that fall-run and late fall-run Chinook salmon did not warrant listing but should remain a Species of Concern for further analysis and evaluation.

Although fall/late fall-run Chinook salmon inhabit a number of watersheds in the Central Valley for spawning and juvenile rearing, the largest populations occur in the mainstem Sacramento, Feather, Yuba, American, Mokelumne, Merced, Tuolumne, and Stanislaus rivers. Fall-run Chinook salmon, in addition to spawning in these river systems, are produced in fish hatcheries located on the Sacramento, Feather, American, Mokelumne, and Merced rivers. Hatchery operations are intended to mitigate the loss of access to upstream spawning and juvenile rearing habitat resulting from construction of dams and reservoirs in the Central Valley and to produce fall-run Chinook salmon as part of the ocean salmon enhancement program to support commercial and recreational ocean salmon fisheries. Fall-run Chinook salmon also support an inland recreational fishery.

Fall-run Chinook salmon spawning escapement numbers for the San Joaquin River were examined for the past 10 years (2005–2014). PFMC (2015) reports that numbers of fall-run adults ranged from a low of 1,394 in 2009 to a high of 15,843 in 2005; preliminary estimates for 2014 are 5,230. For fall-run jacks, the numbers ranged from a low of 164 in 2007 to a high of 4,214 in 2011; preliminary estimates for 2014 are 2,923.

Fall/late fall-run Chinook salmon are anadromous, with spawning and juvenile rearing occurring in freshwater rivers and streams and juvenile and adult rearing occurring in coastal marine waters. Adult fall-run Chinook salmon migrate from the coastal marine waters upstream through San Francisco Bay, Suisun Bay, and the Delta during late summer and early fall (approximately late-June–early-December) to areas of suitable spawning conditions, characterized by the availability of clean spawning gravels, cold water, and relatively high water velocities. Fall-run Chinook salmon spawning occurs between late-September–December, with the greatest proportion of spawning activity occurring from November–early-December; typically greater than 90% of the run has entered the river by the end of November (CDFG 1995). Late fall-run Chinook salmon spawning occurs from early January–April, with peak spawning in April–June (Moyle 2002).

Fall-run Chinook salmon spawning is similar to that of other Chinook salmon. Redds are created in which eggs are deposited and incubated. Although the suitability of gravel substrates for spawning depends largely on fish size, generally Chinook salmon require substrates of 2.5 mm–15 cm (0.1–5.9 in.) (Bjornn and Reiser 1991). Flow velocity also affects spawning gravel selection, however the range in water depth and velocity is very broad (Healey 1991). Studies in northern California found that Chinook salmon from the Yuba and Sacramento rivers preferred velocities of 0.47–0.9 meters per second (mps) (1.55– 2.95 feet per second [fps) and 0.27–0.82 mps (0.9–2.7 fps]), respectively (CDFG 1991). The quality of spawning habitat is also correlated with intra-gravel flow. Raleigh et al. (1986) concluded that optimal gravel conditions includes less than 5 to 10% fine sediments measuring 3.0 mm (0.12 in.) or less in diameter.

The success of fall-run Chinook salmon spawning depends, in part, on seasonal water temperatures. Survival of Chinook salmon eggs and larvae during incubation declines as water temperatures increase to 12 to 16ºC (53.6 to 60.8ºF) (Myrick and Cech 2001). Fall-run Chinook salmon average 5,500 eggs per female and late fall-run Chinook salmon average 5,800 eggs per female (Fisher 1994). The eggs (6.3–7.9 mm [0.25–0.31 in.] in diameter) hatch in three to four months, and the larvae remain in the gravel redd for another two to three weeks before emerging as fry. Late fall-run Chinook salmon embryo incubation can extend through June (Vogel and Marine 1991).

Two principal movements of juvenile fall-run Chinook salmon into the Sacramento-San Joaquin Estuary (the Delta and Suisun, San Pablo, and San Francisco bays) have been identified (Kjelson et al. 1982). A portion of the fry population (40–50 mm [1.57–1.97 in.]) migrates downstream soon after emergence, where they rear in the lower Delta river channels and Suisun Bay during the spring. These fry begin entering the Estuary in January and peak in abundance in February and March. The remaining portion of fry continues to rear in the upstream stream systems through spring until they are physiologically adapted for migration into salt water (a process called smoltification). This later emigration of Chinook smolts (80–90 mm [3.2–3.5 in.] long) occurs from Apri1–early-June; the fish move quickly through the Delta and Suisun and San Pablo bays. Chinook salmon smolts typically use estuaries only as migratory corridors to the ocean (Reimers 1973, Kjelson et al. 1982, Simenstad 1983), whereas fry remain in an estuary until they become larger and environmental conditions stimulate them to move into the ocean. A small proportion of the fall-run Chinook salmon juveniles may, in some systems, rear through summer and fall, migrating downstream during fall, winter, or early spring as yearlings.

Rearing habitat for juvenile fall/late fall-run Chinook salmon includes riffles, runs, pools, and inundated floodplain and is defined by environmental conditions such as water temperature, dissolved oxygen, turbidity, substrate, area, water velocity, water depth, and cover (Bjornn and Reiser 1991, Healey 1991, Jackson 1992). Use of floodplain habitat by juvenile Chinook salmon has been well documented (DWR 1999, Sommer et al. 2001). Sommer et al. (2001) found that floodplain habitat provides better rearing and migration habitat for juvenile salmon than does the main river channel. Environmental conditions and interactions among individuals, predators, competitors, and food sources determine habitat quantity and quality (Bjornn and Reiser 1991).

While in streams, fall/late fall-run Chinook salmon are opportunistic feeders that vary their diet according to seasonal availability. Fry in streams feed extensively on drift insects (Rutter 1904), but zooplankton are more heavily eaten in main river systems and estuaries. Adult and juvenile dipteran insects and crustacean zooplankters, especially cladocerans and copepods, are the principal food items of fry in the Sacramento-San Joaquin Estuary (Kjelson et al. 1982). In the summer months, juveniles primarily feed on drifting aquatic invertebrates, terrestrial insects, and active bottom invertebrates (mainly amphipods and decapods) in the Delta. As they progress through the Estuary their prey items shift from invertebrates to fish larvae. Individual fish, however, do not usually feed on the full range of food available. Larger fish tend to eat larger prey. Feeding can occur at any time of day, but most activity occurs around dusk (Moyle 2002).

Adult Chinook salmon rear in coastal marine waters and forage on fish and macroinvertebrates (e.g., northern anchovy *Engraulis mordax*, Pacific herring *Clupea pallasi*, krill, juvenile rockfish *Sebastes* spp., squid, and crab larvae). Adult fall-run Chinook salmon spawn at ages ranging from approximately 2–5 years old, with most adult fall-run Chinook salmon returning to spawn at age three. Historically, a large proportion of late fall-run adults returned to spawning grounds as 4–5 year old fish (Moyle 2002). Returning adult Chinook salmon do not eat during their migration to spawning areas or during holding before spawning (Moyle et al. 1995), relying only on body fat reserves (Merz and Merz 2004). Chinook salmon, unlike most steelhead, die after spawning.

Fall-run and late fall-run Chinook salmon have a similar life history; the differences between the two runs are related to timing of migration into freshwater, timing of spawning, timing of juvenile emergence, and length of time juveniles remain in freshwater (Moyle 2002) (see Table A-4).

Table A-4. Fall-run and late fall-run Chinook salmon life history traits.

Trait	Fall-run	Late Fall-run
Adult migration period	Late June–early December	October–April
Spawning period	Late September–December	Early January–April
Juvenile period in Delta	March–December	April–June
Juvenile stream residence	1–7 months	7–3 months
Age at spawning	4–5 years	3–4 years
Holding before spawning	Few days–weeks	1–3 months

Source: Moyle et al. 1995, Moyle 2002.

A.4 Effects Analysis

Elements of the proposed Project that could potentially have adverse effects to EFH include the following:

- Improvement(s) of the RSFS (e.g., installation of boat ramps),
- Ongoing operation of the rakes designed to keep the RSFS clean, and
- Ongoing operation and maintenance (O&M) activities in the vicinity of the RSFS.

The project components are described fully in Section 2.2 of the BA.

A.4.1 Potential Effects

The direct and indirect effects from Project activities were assessed to determine impacts to Chinook salmon and its EFH. First, it is important to note that the habitat in the project vicinity is not well suited for Chinook salmon.The presence of large numbers of predatory fishes, dense invasive aquatic vegetation that can lower dissolved oxygen (DO) levels, decrease turbidity, and provide cover for predatory species, making it unfavorable for juveniles and there is a lack of riparian habitat and gravel that would be supportive of juvenile and adult lifestages. This notion is supported by the fact that a very small number of Chinook salmon (n=32 of a total of 8,681 fishes) were collected during 11 years of sieve net sampling conducted at the Headworks prior to construction of the RSFS (Table 23 in BA). That being said, it is possible that winter-run Chinook salmon[2] could occur and it has been documented that low numbers of spring-run (n=11) have been collected during sieve net monitoring. Fall-run have been collected in low numbers (n=18) by sieve net and 40 have been collected by the RSFS rakes. Therefore, the effects of the RSFS improvements, ongoing operation of the rakes, and O&M activities are assessed.

The installation of boat ramps is the only project component that involves offshore in-water construction work, and, as described in Section 2.4.1 of the BA, it will be conducted during the work window of August 1 through October 31 when Chinook salmon are not expected to be present in the work area. A minimal area (0.02 acre) of benthic substrate would be modified for the boat ramps.

The effects of RSFS improvements, RSFS rake operations, and O&M activities that result in increased sound, increased turbidity, and resuspension of sediments will be temporary, short term, and localized, and ambient conditions are anticipated to return soon after these activities

[2] No winter-run were collected from 1999–2009 at the Headworks during CCWD sieve net monitoring.

cease. When motorized boats are used to conduct RSFS improvements or O&M activities there is a possibility that Chinook salmon could be struck by a propeller and die immediately or die later if injured. However, disturbance of water and increased noise from the boat would likely cause winter-run Chinook salmon to temporarily leave the area. In addition, slow boat speeds required for the Project will allow fishes to safely leave the area. The permanent loss of 0.02 acre of benthic habitat in Rock Slough from construction of the boat ramp will have minimal adverse impacts. The community of benthic species, which could provide prey for juvenile Chinook salmon, will be permanently removed in this small area of Rock Slough. Mechanical harvesting and application of aquatic herbicides will occur from June 1 through October 31–a time period when Chinook salmon are not likely to occur offshore of the RSFS.

A.4.2 Avoidance and Minimization Measures for Chinook Salmon

Although effects to Chinook salmon are not considered substantial, the avoidance and minimization measures proposed for listed species (Section 2.4 in the BA) will also be protective of Chinook salmon and its EFH.

A.4.3 Benefits of the Project

The benefits of the Project to Chinook salmon and its EFH include the following:

- Improved screen cleaning will maintain design approach velocities thereby reducing entrainment and impingement impacts to Chinook salmon, and reduce entangling in the aquatic vegetation and subsequent entrapment of salmon in the rake buckets;
- Improved access to the water for maintenance and inspection of the screen, and reduced response time if a boom is required for containing spills; and
- Control of invasive aquatic weeds through mechanical harvesting, application of herbicides, and removal by hand improves aquatic habitat that is compromised by the effects of non-native aquatic vegetation, which increases water clarity, reduces dissolved oxygen levels, entangles fishes, and provides ideal habitat for predatory fishes.

A.4.4 Determination

The proposed Project will have minimal adverse effects to Chinook salmon and its EFH. Project work conducted upstream of the RSFS will not affect Chinook salmon because this area is no longer available to Chinook salmon.

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Appendix B

Contra Costa Water District's Integrated Pest Management Program

Contra Costa Water District
Integrated Pest Management Program

August 2016
Revision 8.1

CONTRA COSTA WATER DISTRICT

1331 Concord Avenue
Concord, CA 94520
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Integrated Pest Management Program
March 2016
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CONTRA COSTA WATER DISTRICT
INTEGRATED PEST MANAGEMENT PROGRAM
August, 2016
Version 8.0

INTRODUCTION

Integrated pest management (IPM) is an ongoing process that minimizes human health and environmental impacts while effectively suppressing pest populations. To be truly effective, the process requires established procedures that not only must be practiced, but undergo a periodic review. These procedures must properly identify pests, monitor pest populations, evaluate a wide variety of pest control strategies, implement the appropriate strategies, continually evaluate the effectiveness and impacts of implementation, and modify the control strategies as necessary.

SUMMARY

The goal of the District's Integrated Pest Management (IPM) Program is to employ a comprehensive set of procedures that optimally combines chemical, biological, and mechanical control alternatives for pest control in a manner that:

1) Maximizes protection of all surface waters;
2) Minimizes pesticide use and requires use of "least toxic" pesticides or methods of pest control;
3) Manages pests effectively using environmentally safe and cost effective practices.

Environmentally safe practices are those that ensure the adequate protection of the public and District employees, are protective of potable water sources, other aquatic and terrestrial resources, and public and private property. An IPM Committee, consisting of members from Operations and Maintenance (various personnel including contractors acting as Licensed Pest Control Advisor), Public Information, Engineering (Manager of Health and Safety), and Planning (Watershed & Environmental Planning and Environmental Compliance Officer) provides program review. An adaptive management strategy allows for future modification of control methods over time, based on the level and risk associated with the pest species, treatment method alternatives and results.

These procedures are to be provided to managers, supervisors and staff who perform pest management as part of their District responsibilities. It is to be strictly followed in implementation of all pest management activities.

PROCEDURES

I GENERAL IPM BEST MANAGEMENT PRACTICES

The following procedures (Best Management Practices) will be implemented and followed by all District personnel who perform pest management on District property and all Reclamation facilities including reservoirs, watershed lands, recreation areas, the canal and other rights-of-way and facility grounds. Reclamation facilities include: Contra Costa Canal, Contra Costa

Pumping Plants, Contra Loma Dam and Reservoir, Short-cut Pipeline, Ygnacio Pumping Plant and Canal, and Martinez Dam and Reservoir. District personnel shall document their control activities and maintain records as noted in these procedures.

A. Identify All Potential Pests

District personnel with responsibility for pest management will be trained to accurately identify pest species of animals and plants, the damage they can cause, and the control alternatives available. Field manuals, a list of Noxious Weeds as identified by the Contra Costa County Agricultural Commissioner and other resources will be made available to staff to assist in pest identification as necessary. A listing of Pests and Noxious Weeds is found in Appendix A. Descriptions and photographs of the pests and noxious weeds in Appendix A are accessible through the appendix via the internet if this IPM Program document is in electronic format (e.g., pdf).

B. Determination of Pest Management Action Level

District personnel with responsibility for pest management shall determine the annual and seasonal infestation levels that are unacceptable. These unacceptable levels are pest management action levels that indicate appropriate action must be taken to prevent damaging infestation. The determination of these levels will be completed using, in most cases, the following criteria:

- it is determined that the pest population will reach a critical level if left untreated;
- biological or environmental factors cannot be expected to reduce the pest problem within a reasonable time; and
- pest management costs (including any environmental or health impacts) are less than the potential pest damage.

If the determination concludes that pest management control action is necessary, District personnel responsible for pest management shall identify and/or implement the appropriate management practice per Section C, *Determine Acceptable Pest Management Practices*.

C. Determine Acceptable Pest Management Practices

1) District personnel responsible for pest management shall determine acceptable pest management practices using the criteria below. These criteria may not be met in every case. Judgment should be used in these cases to determine acceptable pest management practices that are:

    - least damaging to the general environment;
    - least hazardous to human health;
    - less of an impact on non-target organisms;
    - appropriate considering the absence of listed, candidate or locally rare species;
    - most likely to produce a permanent reduction of the pest; and

- most cost-effective in the short and long-term.

2) As pest management practices are developed, they may include a combination of various control alternatives. The preferred methods in an IPM program are those which permanently prevent pest problems in an environmentally sensitive manner, therefore, eliminating the potential for pest damage. A pest management practice may include one or more of the following elements:

- no controls are necessary;
- physical/mechanical controls (hand abatement, soil tilling, discing, mowing, etc.);
- biological controls (grazing by goats or cows, use of predators or parasites);
- chemical controls (ranging from low toxicity materials such as soaps and oils, to least-toxic pesticides); and
- other (mulching, planting alternative vegetation, and/or prescribed burns).

A listing of pests, management objectives, action levels, and acceptable management practices as discussed in Sections A through C above is found in Appendix B, *CCWD Pest Management Program Matrix*. Appendix B also presents the pest management practices' effects to the environment and listed species.

D. Establish a record keeping system

1) Good records are essential for evaluating and improving an IPM program and for reference when management, the Board of Directors, or the public requests information on how the District handles certain types of pest species. District personnel responsible for pest management are required to keep written records to document acceptable pest management practices that include the following:

- the identification of pests at a particular site;
- a description of unacceptable infestation levels and action determination (see Section B above);
- the selection of the acceptable pest management practice for a given site (see Section C above);
- the degree of pest infestation using density, distribution or some other parameter(s); and
- information on how the pest problem was treated including: what, how much, where, when, and who performed the treatment.

2) To evaluate and improve the IPM program, District personnel responsible for pest management shall record the monitoring of selected treatment sites. The monitoring activities shall be implemented as follows using the form found in Appendix C:

- two (2) treated sites in East County and two (2) treated sites in Central County, which are representative of specific treatment applications (i.e., pest, acceptable pest practice, location, etc.), will be selected for monitoring each calendar year.
- each year thereafter, monitoring shall be conducted at different sites such that monitoring does not duplicate or occur at a treated site that is similar in treatment application from the previous year.
- the monitoring shall document short and long-term effectiveness of the treatment;
- any side effects of treatment on non-target organisms;
- citizen complaints or other problems that may arise and other positive feedback;
- copies of monitoring forms will be submitted to the IPM Committee for annual review.

3) The following reports that include the aforementioned records are compiled and prepared by CCWD:

- Monthly Pesticide Usage reports submitted to County Agriculture Commission
- Annual Reports as required by the Statewide NPDES Permit for Aquatic Pesticide Discharges from Algae and Aquatic Weed Control Applications
- Reports as required by Reclamation for applications within the unlined Canal or at the Rock Slough Fish Screen.

Project-specific permits and agreements for the construction or operation of CCWD facilities, e.g., Canal Encasement, Middle River Fish Screen, may also require periodic reporting that are dependent on the records described above. Pesticide usage reports are also addressed in section VIII.

E. Consideration of Endangered Species

District personnel responsible for pest management must give consideration of threatened or endangered species prior to implementing pest management practices. Special precautions or mitigation measures may be required to prevent harm under certain conditions. Although pesticide use as specified under the pesticide product labeling requirements currently satisfies all legal requirements regarding pesticide use and endangered species protection, it is CCWD's practice to minimize impacts to all non-target organisms including threatened and endangered species to best extent possible when implementing a pest management practice.

Several resources are available to assist with the identification and protection of threatened or endangered species. These include maps and guidance documents that should be consulted prior to pest management activities to determine if threatened or endangered species may exist in a proposed pesticide application area. Following are specific resources that are available to CCWD personnel:

- The CCWD guidance document, *Routine Operations and Maintenance Implementation Plan for Central Valley Projects* (June 2006) – This document provides maps that show areas of listed and sensitive species in relationship to Bureau facilities. It provides the user with a tool to identify timeframes for periods of allowable routine operations and maintenance activities in consideration of the listed and sensitive species habitat. This is a standalone document produced by CCWD.

- Bureau of Reclamation maps showing known sightings of threatened or endangered species for CCWD. These maps are found in Appendix D.

- The EPA website provides extensive guidance on use of pesticides where there could be an impact on protected species. There are currently two court issued injunctions limiting the use of certain pesticides in the Bay Area while EPA makes effect determinations on protected species found in the Watershed and Conservation lands. The limitations for California red-legged frog are detailed at http://www.epa.gov/espp/litstatus/redleg-frog/rlf.htm and limitations for California tiger salamander, Alameda whip snake and San Joaquin kit fox can be found at http://www.epa.gov/oppfead1/endanger/litstatus/factsheet.html. An older EPA document, *Protecting Endangered Species – Interim Measures for Use of Pesticides in Contra Costa County* (March 2000) may also provide some useful tips. This document contains methods to assess the potential need for and recommend specific use limitations in areas where threatened or endangered species may exist. A copy of this document is found in Appendix E.

- Los Vaqueros Resource Management Plan (2015). See in particular Chapter 4.7 Integrated Pest Management Program. The Resource Management Plan (RMP) incorporates the conditions related to pest management from the USFWS Programmatic Biological Opinion for O&M at Los Vaqueros Watershed (Number 08ESMF00-2012-F-0646), the CDFW Incidental Take Permit (Number 2081-2011-002-03), and the CDFW Lake and Streambed Alteration Agreement (Number 1600-2010-0346-R3), and details the Environmental Clearance process required prior to initiation of pest management activities in the Watershed.

- Contra Costa Water District Habitat Management Plan (HMP) (2015). This document sets forth the conditions related to pest management from applicable environmental permits on the Conservation Lands.

F. Ongoing IPM Program Review

The District, through the IPM Committee, will evaluate its IPM Program annually to ensure the procedures strive to achieve the goals through an adaptive management process. The annual evaluation will include the following:

- review the IPM Best Management Practices to ensure that responsible District personnel employ the practices, and revise the practices if necessary to achieve the goals.
- review monitoring records from the current or previous year(s) to determine if the acceptable pest management practice is appropriate or requires alteration to achieve the program goals.

Outside resources that may be requested to assist in an IPM evaluation would include the University of California Statewide IPM Project (916-752-7671), the Alameda and Contra Costa County Cooperative Weed Management Committee, the University of California Cooperative Extension Office (925-670-5200), or private consulting firms.

II PESTICIDE USAGE PRACTICES

A. General District Pesticide Use Practices

District personnel responsible for pest management may determine that chemical pesticide use is necessary. In this circumstance the following District-wide pesticide usage shall apply:

1) Only approved "least toxic" pesticides will be used to minimize the overall risk to the applicator and impact to the environment.

2) All federal, state and local laws and regulations will be strictly adhered to:

Federal:	U.S. EPA Air and Toxics Division, Pesticides	(415) 744-1087
State:	Cal-EPA Department of Pesticide Regulation	(916) 445-4300
	Regional Office in Richmond	(510) 669-0295
Local:	Alameda County Agricultural Commissioner	(510) 670-5232
	Contra Costa County Agricultural Commissioner	
	• Brentwood Office	(925) 634-5682
	• Concord Office	(925) 646-5250
	Alameda and Contra Costa County Weed Management and Cooperative	(925) 646-5250

3) All chemical product label instructions will be strictly followed, including utilizing the personal protective equipment recommended by the manufacturer of the product.

4) Prior to pesticide use, evaluate the site for spot treatment. If appropriate, use spot treatment to minimize pesticide use.

5) Least toxic pesticides will be applied at the appropriate time and under prerequisite weather conditions to maximize their effectiveness on the target species. The likelihood of discharging non-degraded pesticides in storm water runoff will be minimized.

6) Pesticides will not be mixed adjacent to a storm drain inlet, culvert or watercourse. Mix in an area where spillage, if it occurs, can be easily contained.

7) Pesticide use and application techniques selected for along roadside berms will be implemented to retain some vegetative presence to minimize soil erosion, slow the rate of storm water runoff, and minimize potential for contaminated runoff.

8) Calibrate field equipment regularly to ensure the desired application rate.

9) Mix only as much material as necessary for the application.

10) Maintain a record of pesticide usage. That record shall include the type and quantity of pesticide used. Report to County Agricultural Commission monthly on pesticide usage.

11) When an area is to be treated with a pesticide whose label requires notification or posting, adequate notification or posting will be conducted prior to the application. The Public Information Department will be contacted at least one week prior to the application to coordinate any public notice information needed.

12) Pesticides shall not be applied on treatment plant grounds without specific approval of the proposed application by the plant supervisor. On District reservoir lands, pesticides shall be used in accordance with the product label, potentially for rodent control (see Section B-3 below for Los Vaqueros Pesticide Applicants) and for insect control (ants, yellow jackets, etc.).

13) New or substitute products (least toxic-Class 3 only) may only be used with IPM Committee approval. Approval may be obtained via email.

14) On the banks of the Contra Costa Canal and on the lands draining into Martinez, Mallard and Contra Loma reservoirs, pesticide use is limited to necessary spot treatment of vegetation for fire prevention at road crossings and for access to specific structures. Additional applications will be limited to specific pest infestations and will require specific approval of the proposed application by the Director of Operations and Maintenance. The only pesticides that can be considered for these vegetation control applications are Rodeo/Aqua Master (when the gradient is toward the water) and Roundup (when the gradient is away from the water), and then only with strict compliance to labeled instructions for use.

15) Except as noted in D.2, visually monitor success of the pesticide treatment and adjust future potential usage based on visual monitoring results.

B. Los Vaqueros Watershed and Conservation Lands

The RMP and HMP provide the current guidance for use of pesticides on the Watershed and the Conservation Lands, respectively. The following are general guidelines.

1) The use of pesticides, including fungicides and rodenticides, will be limited to protection of health and safety and will be consistent with the RMP and HMP.

2) Herbicides will not be applied within breeding habitat for aquatic amphibians.
3) Pesticides used at the Watershed is subject to the stipulated injunctions affecting the use of certain chemicals in endangered species habitat. See the website references under IE above.
4) Insecticides will not be used within any stream zone without prior written permission from CDFW.
5) Mosquito abatement activities must be approved by the U.S. Fish and Wildlife Service prior to initiation or application.
6) In accordance with the RMP and HMP, CCWD shall prohibit widespread use of rodenticides. Squirrel and rodent control efforts will be focused only in localized areas where needed to avoid public health problems or to prevent damage to building foundations, roadways, and other facilities. Control efforts will emphasize non-toxic means (e.g., trapping); where localized rodenticide use is required, the poison least toxic to nontarget organisms will be selected. All rodenticide use will be conducted under the County permit system (CESA MOU 9339 Duty 4a and 1993 San Joaquin Kit Fox Biological Opinion, page 4, paragraph 4).

The use of copper compounds to treat algal overgrowth in the Los Vaqueros Reservoir will be in accord with resource agency approvals. Copper use at Los Vaqueros Reservoir is also subject to the regulatory agency provisions described in Section C.

C. Canal and Raw Water Reservoirs

Aquatic pesticide use in the canal and raw water reservoirs is regulated under the Statewide General National Pollutant Discharge Elimination System (NPDES) for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States (general permit). The current general permit identifies specific monitoring and reporting requirements on pesticide use, became effective December 1, 2013 and shall expire on November 30, 2018. CCWD's compliance efforts are coordinated through the implementation of the Aquatic Pesticide Application Plan (APAP). The APAP provides procedures to ensure that aquatic pesticide use is minimized, appropriate for the treatment conditions, properly monitored, and does not exceed the respective receiving water limits. Additionally, the APAP includes provisions such as Best Management Practices (BMPs) that encourage the least toxic aquatic pest treatment methods including pesticide alternatives. Following are the BMPs related to IPM Program:

1) Alternatives to pesticide use will be evaluated to determine if there are feasible means to reduce potential water quality impacts.
2) The control efficacy and water quality impacts must be evaluated to refine aquatic pesticide use through adaptive management process.

To comply with the above general permit requirements the Aquatic Pesticide Users Group, which was established to specifically comply with the general permit, will present and/or provide relevant current information at IPM Committee meetings to ensure that the practices are consistent with IPM program goals. Examples of this information include:

1) Successful alternatives to pesticide use;
2) Alternatives under evaluation and related progress reports;
3) Post treatment site observations; and
4) Water quality monitoring data.

III APPROVED PESTICIDE LIST

The following least toxic pesticides are currently approved for use and application by District staff and contractors on District property, rights-of-ways or other areas where chemical pest control has been determined to be necessary:

Product Name	EPA/California Registration No.*
Aquathol K	70506-176
Aquathol Super K Granular	70506-191
Capstone	62719-572
Cascade	70506-176
Clarity	7969-137
Clearcast	241-437-67690
Clearigate	8959-51
Captain XTR	67690-9
Current	70506 – 240
Cutrine Plus	8959-10
Cutrine Ultra	8959-53
Diphacinone Treated Grain	10965-50001-ZA
Diazinon (Knox out 2FM ant spray)	Multiple products and registration #'s
Dimension EC	62719-426
Dimension 2 EW	62719-542
Dimension Ultra 40WP	62719-445
Harpoon Aquatic	8959-54
Harpoon Granular	8959-55
Green Clean	70299-2
Green Clean 2.0	70299-12
Komeen	67690-25
Nautique	67690-10
PAK 27	68660-9
Phycomycin	68660-9-8959
Prospreader Activator	1050775-50022-AA
R-11 Spreader-Activator	2935-20142
Rodeo/Aqua Master	524-343
Roundup Custom	524-343
Roundup Pro	524-529
Speed Zone	2217-833
Sonar A.S.	67690-4
Sonar SRP	67690-3
Symmetry	70506 – 249
Teton	70506-175
Tripleline Foam-Away	1050775-50023-AA

❄ EPA/California Registration Numbers are listed on the pesticide containers and are specific to the formulation of the pesticide. These numbers will change if a manufacturer changes a formulation, regardless of any change in the product name. Always check EPA/California Registration Number to confirm that product is consistent with the above list. Rodenticides with the anticoagulants chlorophacinone and diphacinone are also approved for use.

This list with active links to both pesticide labels and Safety Data Sheets (SDS) is now available on the District drive in the Environmental Compliance folder (under Regulatory Plans\Integrated Pest Management Plan).

IV TRAINING AND CERTIFICATION

A. District personnel who apply pesticides requiring a certification shall obtain a state pesticide applicator certification or work under the direction of an employee who has obtained the state certification.

B. District personnel who apply pesticides shall be trained in general IPM practices, the safe use of pesticides and proper inspection of applicator equipment to prevent accidental pesticide leaks, spills, and potential hazards to applicators and the environment. Each work unit shall maintain records of who received the training for at lease three years. New employees shall not apply pesticides until they have received the appropriate training or until their supervisor confirms that they have met the training objectives at their previous job.

C. District personnel who apply pesticides will be trained in procedures and methods to identify and protect Endangered Species during the use and application of pesticides. These training sessions will be coordinated through Reclamation.

V PESTICIDE STORAGE

A. Pesticides shall be stored indoors in locked and labeled storage units or within locked District facilities.

B. Pesticide containers must be clearly labeled to indicate the name of the pesticide, signal word and company name.

C. Pesticides stored that reach their expiration date shall be disposed of per the procedures described in Section IV, *Pesticide Disposal*.

VI PESTICIDE DISPOSAL

A. Triple rinse empty pesticide containers with water immediately upon emptying contents. Place rinse water in spray tank incorporating it into the pesticide mixture and apply it.

B. Dispose of triple rinsed empty pesticide containers according to County Agricultural Commission and manufacturer’s recommendations.

C. Dispose of the container rinse water or spray tank rinse water as a product over the target site.

D. If possible, unwanted or unused pesticides should be returned. If you have unwanted pesticides:

1) contact other District work units to determine if they can use the pesticide in their operation;

2) if the container is unopened, attempt to return it to the manufacturer; or
3) attempt to find a qualified buyer for the pesticide.

If returning an unwanted pesticide is not feasible or disposal of outdated pesticide is necessary, contact the Environmental Compliance Officer to arrange for disposal.

VII PESTICIDE SPILL RESPONSE

A. Spill kits will be prepared and maintained at pesticide storage areas and on all application equipment that has a tank capacity of 50 gallons or more.

B. Spill kits should include the following:

- an instruction sheet with contact notification list and phone numbers;
- absorbent material capable of absorbing up to five gallons of liquid;
- shovel, broom, dustpan, gloves; and
- warning tape to secure the area in case clean-up cannot be accomplished immediately.

C. District personnel who apply pesticides will be trained in the use of the spill kits.

D. District personnel responsible for pest management shall maintain a written pesticide spill response and notification procedure, and all employees who apply pesticides shall be familiar with the notification procedure.

VIII PESTICIDE USAGE REPORTS

A. The CCWD Operations and Maintenance department shall produce a monthly Pesticide Usage Report and provide it to the County Agriculture Commission.

B. The Environmental Compliance Officer shall produce Annual Reports that include monitoring and analytical results of copper-containing aquatic pesticides as required by the Statewide NPDES Permit for Aquatic Pesticide Discharges from Algae and Aquatic Weed Control Applications.

C. Additional reports for the Los Vaqueros watershed are only required for submittal to oversight agencies: All rodenticide use within the Los Vaqueros watershed shall be reported to the California Department of Fish and Game on a quarterly basis and to the U.S. Fish and Wildlife Service on an annual basis.

IX ROLE OF THE IPM COMMITTEE

The IPM Committee shall meet as needed to provide oversight of the District’s IPM Program and Procedures. The IPM Committee shall also be responsible for issuing and updating this IPM Program Summary and Procedures, as necessary. The Committee chair will rotate annually among the member departments.

IPM Committee responsibilities shall include:

A. annual review of IPM Program Summary and Procedures including revisions,
B. periodic review of IPM Program Summary and Procedures if necessary; and
C. as necessary, review of requests for new pesticides for possible addition to the list of approved least-toxic pesticides.

APPENDIX A

CONTRA COSTA COUNTY LIST OF NOXIOUS WEEDS

Pests and Noxious Weeds in Contra Costa County

Rating	Genus	Species	Common Name	Pest Category
C	Malvella	leprosa	alkali sida	Broadleaf
B	Cynara	cardunculus	artichoke thistle	Perennial
B	Aegilops	triuncialis	barb goatgrass	Grass
C	Cynodon	spp.	bermudagrass	Grass
C	Salsola	tragus	common Russianthistle	Perennial
C	Convolvulus	arvensis	field bindweed	Broadleaf
C	Genista	monspessulana	French broom	Broadleaf
B	Cardaria	pubescens	Globe-podded hoarycress	Broadleaf
B	Cardaria	draba	heart-podded hoarycress	Broadleaf
C	Carduus	pycnocephalus	Italian thistle	Broadleaf
C	Sorghum	halepense	Johnsongrass	Grass
C	Hypericum	perforatum	Klamathweed	Broadleaf
B	Cardaria	chalepensis	lens-podded hoarycress	Broadleaf
C	Taeniatherum	caput-medusae	medusahead	Broadleaf
B	Euphorbia	oblongata	oblong spurge	Broadleaf
B	Lepidium	latifolium	perennial peppercress	Broadleaf
C	Tribulus	terrestris	puncturevine	Broadleaf
B	Lythrum	salicaria	purple loosestrife	Broadleaf
B	Centaurea	calcitrapa	purple starthistle	Perennial
B	Elytrigia	repens	quackgrass	Grass
B	Acroptilon	repens	Russian knapweed	Broadleaf
C	Cytisus	scoparius	Scotch broom	Broadleaf
C	Carduus	tenuiflorus	slenderflowered thistle	Broadleaf
B	Solanum	elaeagnifolium	white horsenettle	Broadleaf
B	Cyperus	esculentus	yellow nutsedge	Perennial
C	Centaurea	solstitialis	yellow starthistle	Perennial
Non-rated	Centaurea	melitensis	Malta starthistle	Perennial
Non-rated	Acacia	melanoxylon	black acacia	Perennial
Non-rated	Cirsium	vulgare	bullthistle	Broadleaf
B	Cyperus	rotundus	purple nutsedge	Broadleaf
Non-rated	Egeria	densa	brazilian elodea	Floating/Submersed
Non-rated	Elodea	canadensis	common elodea	Floating/Submersed
Non-rated	Senecio	vulgaris	Common groundsel	Broadleaf
Non-rated	Solanum	nigrum	Black nightshade	Broadleaf
Non-rated	Polygonum	lapathifolium	Smartweed	Hydrophyte
Non-rated	Eichhornia	crassipes	Water Hyacinth	Floating/Submersed
Non-rated	Myriophyllum	spicatum	Eurasian Milfoil	Floating/Submersed
N/A	Spermophilus	beecheyi	Ground Squirrel	Burrowing Rodent
N/A	Thomomys	bottae	Gopher	Burrowing Rodent
N/A	Vespula	germanica	Yellowjacket	Nuisance Pest
N/A	Dolichovespula	maculata	Hornet	Nuisance Pest
N/A	Vespula	vulgaris	Wasp	Nuisance Pest
Non-rated	Nicotianna	glauca	Tobacco Tree	Tree
N/A	Apis	melifera	Honey Bee	Nuisance Pest

Non-rated	Quercus	multiple	Oak Tree	Tree
Non-rated	Salix	lasiolepis	Willow Tree	Tree
Non-rated	Toxicodendron	diversilobum	Poison Oak	Tree
Non-rated	Rubus	ursinus	Blackberry	Shrub
Non-rated	Various	various	Blue Green Algae (Cyanobacteria)	Algae
Non-rated	Typha	latifolia	Cattail	Hydrophyte

Ratings:

"B" An organism of known economic importance subject to: eradication, containment, control or other holding action at the discretion of the individual country agricultural commission. **OR**

An organism of known economic importance subject to state endorsed holding action and eradication only when found in a nursery.

"C" An organism subject to no state enforced action outside of nurseries except to retard spread. At the discretion of the commissioner.

"N/A" – Not Applicable

APPENDIX B

PEST CONTROL PROGRAM MATRIX

Contra Costa Water District
Pest Management Program Matrix

Pest*	Locations/Facilities	Management Objective	Action Level	Management Practice(s)
Aquatic Weeds*				
Algae*	Canal and Reservoirs	Control non-native invasive species; maintain flow in conveyance structures; and/or prevent taste and odor issues.	Phytoplankton count exceeds WQ standard and/or Flavor Profile Analysis dictates action.	Diver assist vacuum, apply algaecide
	Reservoirs	Control non-native invasive species; and/or prevent taste and odor issues.	15% of water surface area infested with filamentous algae.	Diver assist vacuum, apply algaecide
Floating/Submersed*	Canal and Reservoirs	Control non-native invasive species; and/or maintain flow in conveyance structures.	Zero tolerance	Mechanical harvesting, apply algaecide
Emergent Hydrophytes*	Canal and Reservoirs	Control non-native invasive species; maintain flow in conveyance structures; allow access to perform operations and maintenance activities; and/or allow access for recreational use.	Zero tolerance	Apply post-emergent herbicide
* see Appendix A				

Contra Costa Water District
Pest Management Program Matrix

Pest*	**Management Practice(s)**	**Environmental Effects**	**Effects to listed Species**
Aquatic Weeds*			
Algae*	Diver assist vacuum, apply algaecide	Removal of fixed algae by diver assist vacuum is localized treatment method that removes a majority of the target organism with little if any other effects to the environment. This management practice is followed by an application of algaecide within 50 yards of the vacuumed area (e.g., inlet tower) to kill remaining algae. Fish in the immediate area will migrate to areas away from the treatment area.	
	Diver assist vacuum, apply algaecide	This management practice eliminates food source for algae resulting in die-off of algae. Treatment area is limited to reservoir shoreline allowing fish to migrate away from these areas.	
Floating/Submersed*	Mechanical harvesting, apply algaecide	Mechanical harvesting can cause fragmentation and propagation of aquatic weeds in other areas of the water body. Algaecide application will kill the aquatic weeds, and may reduce dissolved oxygen levels. However, the application is done in a manner (e.g., no more than 1/2 the surface treated) to allow fish to migrate away from the treatment area.	
Emergent Hydrophytes*	Apply post-emergent herbicide	Spot treatment, outside of the water body, kills target organism. Some potential for runoff after precipitation event.	
* see Appendix A			

Contra Costa Water District
Pest Management Program Matrix

Pest*	Locations/Facilities	Management Objective	Action Level	Management Practice(s)
Terrestrial Weeds*				
Annual Broadleaf*	All facilities	Allow safe access to facilities to perform operation and maintenance activities; prevent damage to structures and canal liner; control non-native invasive species; and/or fire prevention.	Zero tolerance along trails, fence line, at structures, and roadways. Root system tolerated on specified slopes and canal banks, and dam face to mitigate erosion.	Mowing and discing. Pre-emergent and post-emergent herbicide applications.
Annual Grasses*	All facilities	Allow safe access to facilities to perform operation and maintenance activities; prevent damage to structures and canal liner; control non-native invasive species; and/or fire prevention.	Zero tolerance along trails, fence line, at structures, and roadways. Tolerated on specific slopes and canal banks.	Mowing and discing. Pre-emergent and post-emergent herbicide applications.
Perennials*	All facilities	Allow safe access to facilities to perform operation and maintenance activities; prevent damage to structures and canal liner; control non-native invasive species; and/or fire prevention.	Zero tolerance	Mowing and discing. Pre-emergent and post-emergent herbicide applications.
Shrubs/Trees*	Canal liner	Prevent damage to structures and canal liner	Zero tolerance within 15 feet of the canal.	Post-emergent cutting, applying post-emergent herbicide
* see Appendix A				

Contra Costa Water District
Pest Management Program Matrix

Pest*	Management Practice(s)	Environmental Effects	Effects to listed Species
Terrestrial Weeds			
Annual Broadleaf*	Mowing and discing. Pre-emergent and post-emergent herbicide applications.	Vegetation growth would be minimal in areas where pre-emergent herbicides are applied. Emerged plants killed with post-emergent herbicides. Pesticide residues on soil particles, and breakdown products present at site. Herbicide residue may enter the canal with drift, solubilization and runoff during precipitation events, or movement of soil particles with adhered material.	
Annual Grasses*	Mowing and discing. Pre-emergent and post-emergent herbicide applications.	Vegetation growth would be minimal in areas where pre-emergent herbicides are applied. Emerged plants killed with post-emergent herbicides. Pesticide residues on soil particles, and breakdown products present at site. Herbicide residue may enter the canal with drift, solubilization and runoff during precipitation events, or movement of soil particles with adhered material.	
Perennials*	Mowing and discing. Pre-emergent and post-emergent herbicide applications.	Vegetation growth would be minimal in areas where pre-emergent herbicides are applied. Emerged plants killed with post-emergent herbicides. Pesticide residues on soil particles, and breakdown products present at site. Herbicide residue may enter the canal with drift, solubilization and runoff during precipitation events, or movement of soil particles with adhered material.	

Contra Costa Water District
Pest Management Program Matrix

Pest*	Management Practice(s)	Environmental Effects	Effects to listed Species
Terrestrial Weeds			
Shrubs/Trees*	Post-emergent cutting, applying post-emergent herbicide	Spot treatment minimizes effects to non-target organism. Herbicide residue may enter the canal with drift, solubilization and runoff during precipitation events, or movement of soil particles with adhered material.	
* see Appendix A			

Contra Costa Water District
Pest Management Program Matrix

Pest*	Locations/Facilities	Management Objective	Action Level	Management Practice(s)
Mammals*				
Burrowing Rodents*	All facilities	Prevent damage to structures and canal liner.	Zero tolerance along canal and face of dam.	Pre and post rodenticides
Burrowing Rodents*	All facilities	Prevent damage to structures and canal liner.	Zero tolerance along canal and face of dam.	Pressurized carbon monoxide
* see Appendix A				

Contra Costa Water District
Pest Management Program Matrix

Pest*	Management Practice(s)	Environmental Effects	Effects to listed Species
Mammals*			
Burrowing Rodents*	Pre and post rodenticides	Rodenticides placed in bait station that limits access to target organism and exposure to the environment.	
Burrowing Rodents*	Pre and post rodenticides	Pressurized carbon monoxide is injected into the rodent burrow to targeted pest with no exposure to the environment.	
* see Appendix A			

Contra Costa Water District
Pest Management Program Matrix

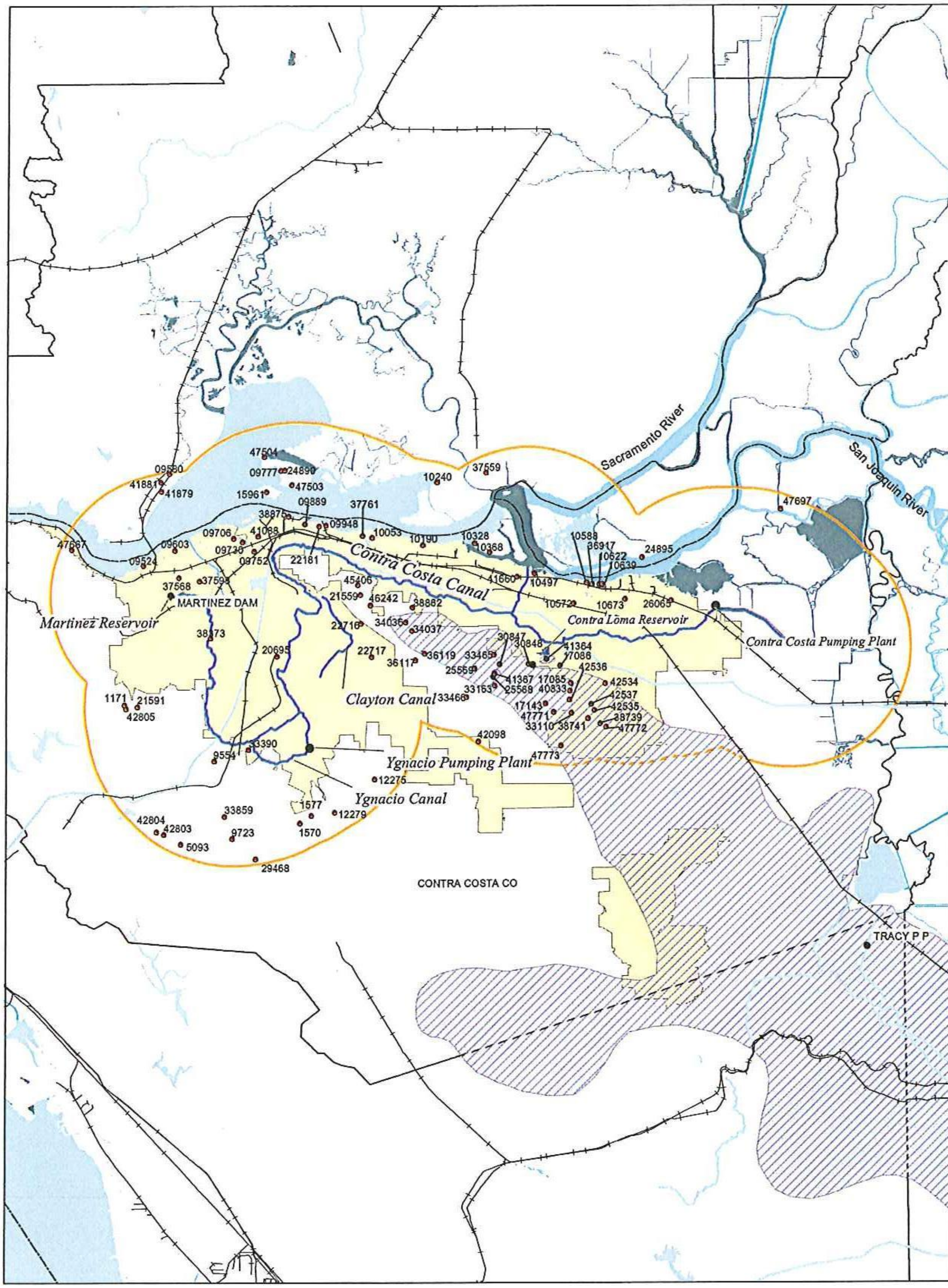
Pest*	Locations/Facilities	Management Objective	Action Level	Management Practice(s)
Insects & Other Invertebrates*				
Nuisance Pests*	All facilities	Allow safe access to facilities to perform operation and maintenance activities. Allow safe public access to recreational trails and facilities.	Zero tolerance within 100 yards of work site and/or area for operations and maintenance activities. Zero tolerance when notified by public for recreational use and/or access.	Beekeeper to relocate bee hive or apply insecticide. Apply insecticide for all other nuisance pests.
* see to Appendix A				

Contra Costa Water District
Pest Management Program Matrix

Pest*	Management Practice(s)	Environmental Effects	Effects to listed Species
Insects & Other Invertebrates*			
Nuisance Pests*	Beekeeper to relocate bee hive or apply insecticide. Apply insecticide for all other nuisance pests.	Localized treatment minimizes environmental effects. Potential for runoff into canal when used in immediate area.	
* see Appendix A			

APPENDIX C

Bureau of Reclamation Threatened and Endangered Species Maps

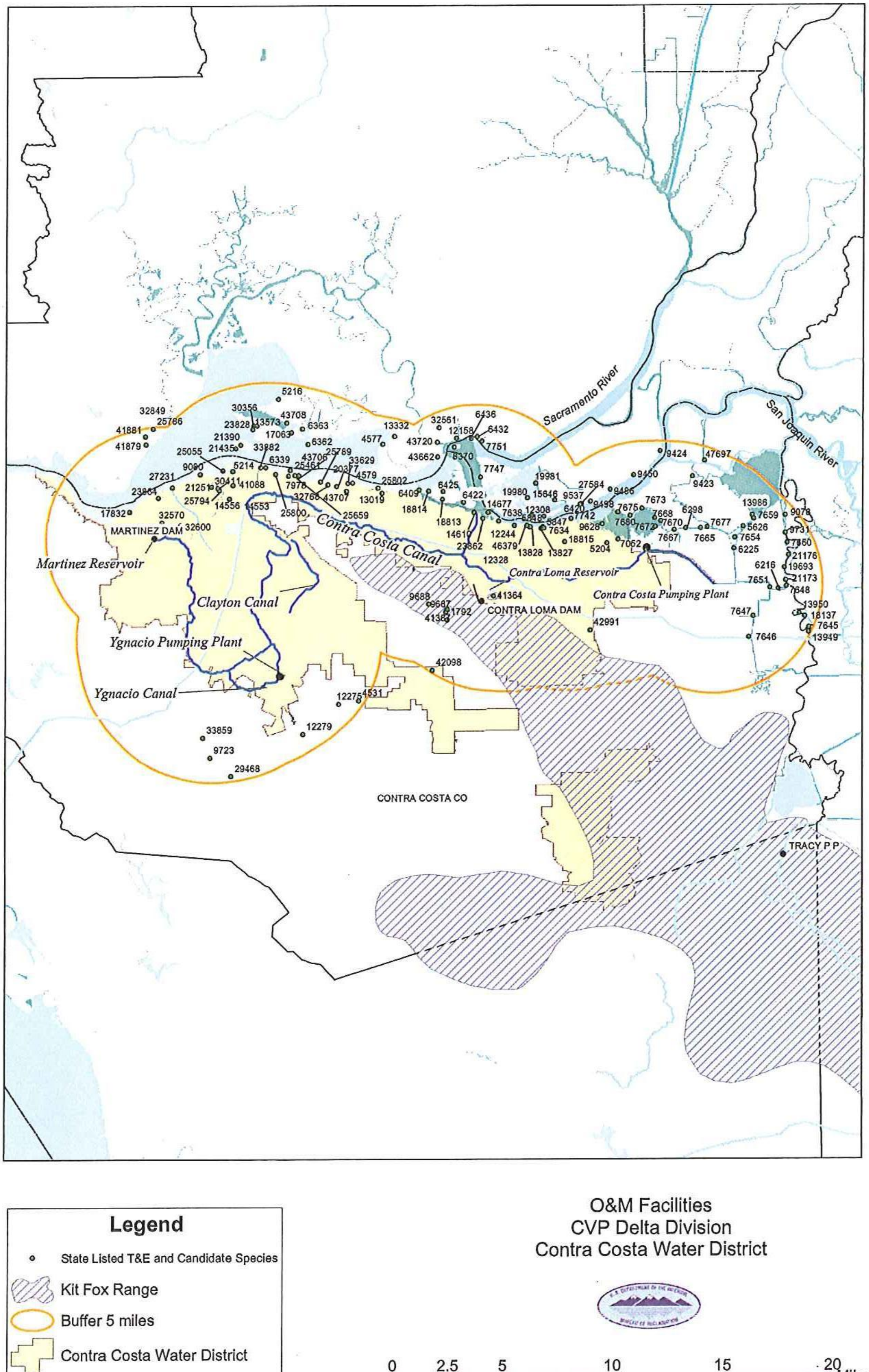


Legend

- Federally Listed T&E and Candidate Species
- Kit Fox Range
- Buffer 5 miles
- Contra Costa Water District

0 2.5 5 10 15 20 Miles

O&M Facilities
CVP Delta Division
Contra Costa Water District



O&M Facilities
CVP Delta Division
Contra Costa Water District

APPENDIX D

United States Environmental Protection Agency
Protecting Endangered Species
Interim Measures for Use of Pesticides in Contra Costa County

United States
Environmental Protection
Agency

March 2000

Pesticides And Toxic Substances (H-7506C)

Protecting Endangered Species
Interim Measures for Use of Pesticides in Contra Costa County

The federal Endangered Species Act is intended to protect and promote the recovery of animals and plants that are in danger of becoming extinct due to human activities. Under the Act, the U.S. Environmental Protection Agency (U.S. EPA) must ensure that the use of pesticides it registers will not result in harm to the species listed as endangered or threatened by the U.S. Fish and Wildlife Service, or to habitat critical to those species' survival. This program will protect endangered and threatened species from harm due to pesticide use.

The information provided in this bulletin is similar to what U.S. EPA expects to distribute once the Endangered Species Protection Program is in effect. Individuals who use pesticides during this interim period are not legally required to comply with these suggested measures. At the present time, compliance with the requirements specified on the pesticide product labeling will satisfy all legal requirements regarding pesticides and endangered species protection. While these pesticide use conditions do not yet have the force of law, they are being provided now for your use in voluntarily protecting endangered and threatened species.

Your comments are needed regarding the information presented in this publication. Please contact us to let us know whether the information is clear and correct. Also tell us to what extent following the recommended measures would affect your pesticide use program. This information will be considered by U.S. EPA during the final stages of program development.

Please submit comments to:
DPR Pesticide Registration Branch
830 K Street
Sacramento, CA 95814
(916) 324-3881
rmarovich@cdpr.ca.gov
http://www.cdpr.ca.gov/docs/es/index.htm

About This Publication

This publication contains a map of the county including a shaded area where pesticide use should be limited to protect listed species. In the Section List, you will find additional information on the individual species that occur in each section, indexed by county, township, range and section.

The Species Descriptions table lists the taxonomic groups for each species. The Active Ingredients tables list certain pesticides and the activity category (mode of action, etc.) of the pesticide and the taxonomic groups they could adversely affect. The use limitations in this bulletin apply only to listed pesticides where the hazard class of the pesticide matches the hazard class (sensitivity of the taxonomic group) of the species that occur in the section where the pesticide will be used. Within a given section, use limitations only apply to sites that are consistent with habitat as noted in the Species Descriptions table. The Use Limitation Codes table indicates which use limitation codes apply to each species. The Use Limitations table translates limitation codes to use limitations.

Does This Information Apply To You?

To determine whether this information applies to your use of a pesticide, review the questions below. The information applies only if you answer "yes" to all three of these questions:

- Do you intend to use pesticides within the shaded area on the map (p 3) that is further detailed in the Section List (p 39)? If so, note the species from the Section List.
- Are any of the ingredients included in your pesticide product named in the Active Ingredients tables (p 8, 15, 19, 22, 25)?
- If so, does the hazard class(es) of the pesticide you intend to use match one or more of the taxonomic groups of the species as shown in the Species Descriptions table (p 32)?

If you answer "yes" to all three questions, you should follow the instructions on "How to Use This Information" (p 2) to help protect listed species.

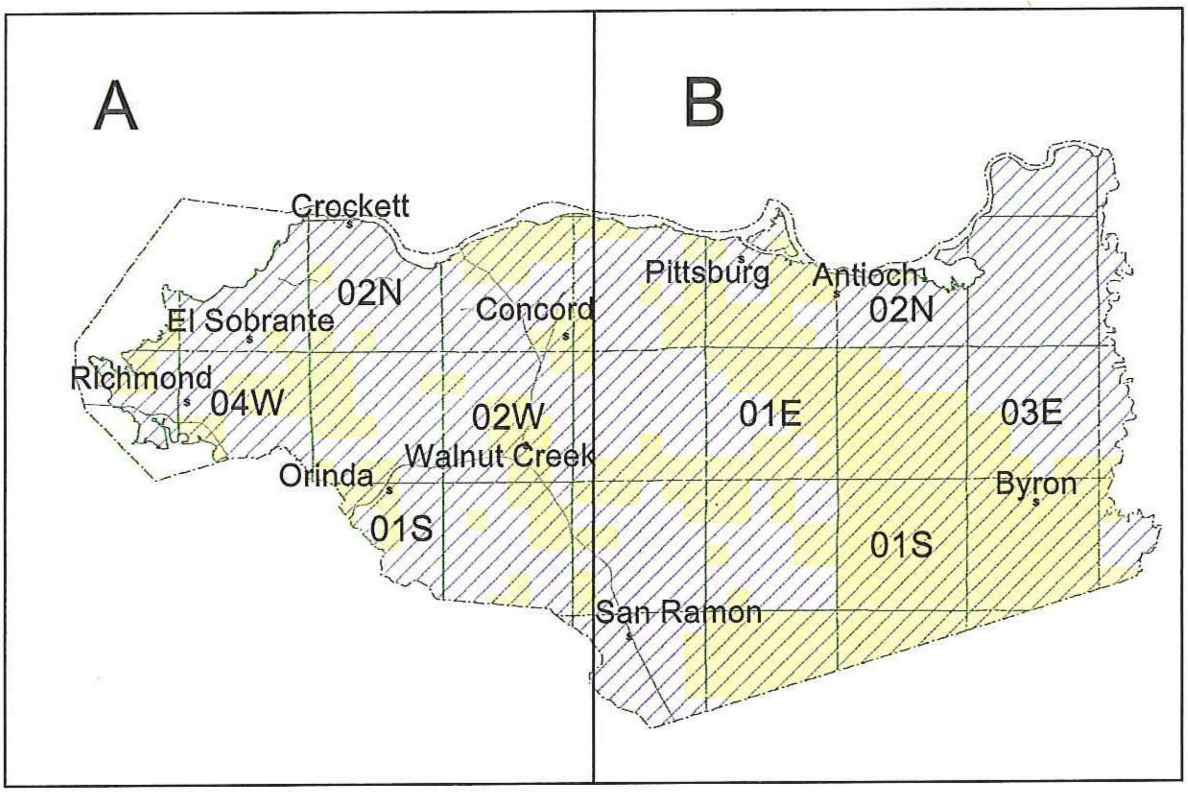
If you answer "no" to any of the above questions, this bulletin does not apply to you.

How to Use This Information

See worksheets for each class of pesticide that you intend to use:

Worksheets	Page
Herbicides	6
Insecticides	13
Fungicides	18
Rodenticides - Grain Baits	21
Rodenticides - Fumigants	24

Distribution of Species Addressed in This Bulletin

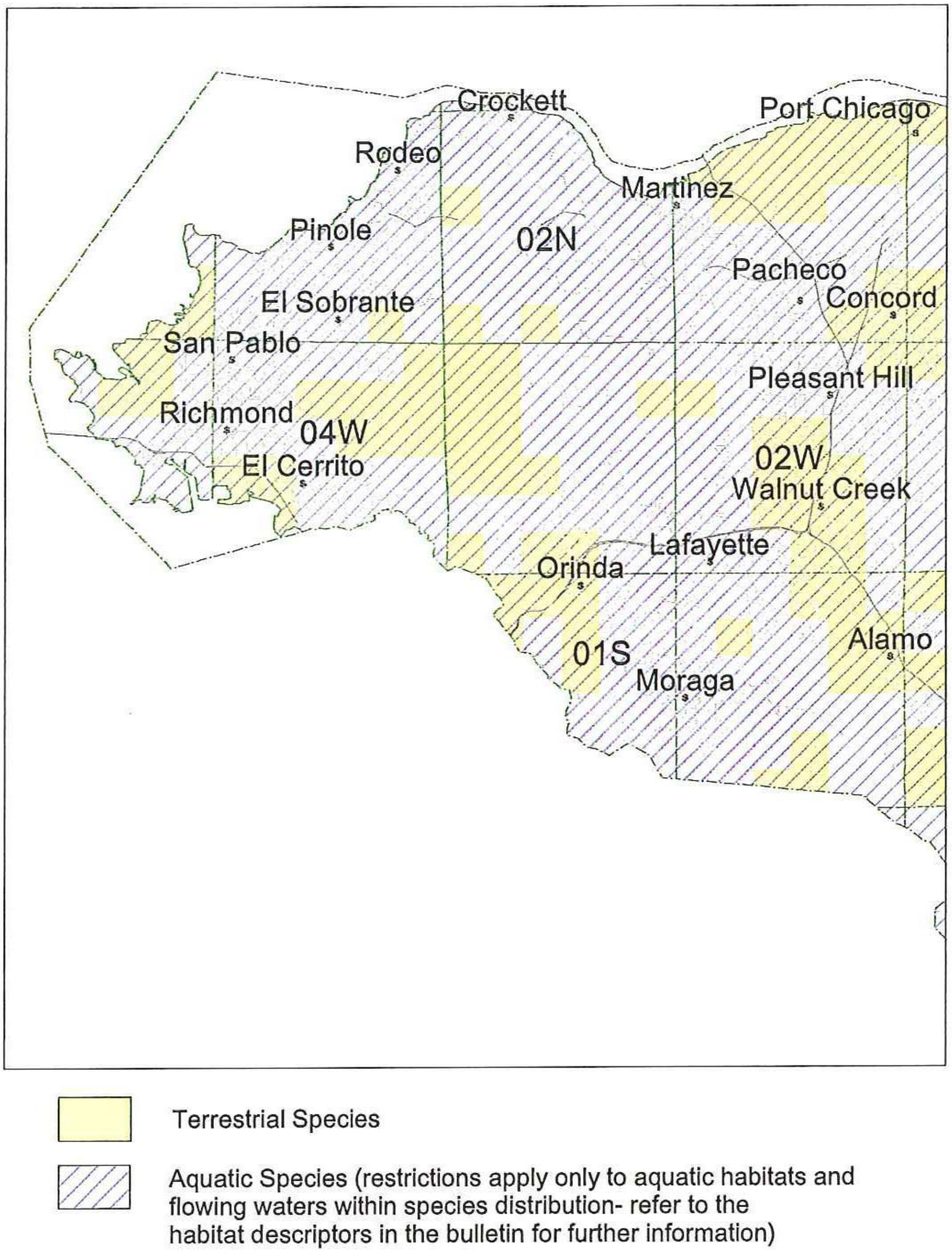


Terrestrial Species

Aquatic Species (restrictions apply only to aquatic habitats and flowing waters within species distribution- refer to the habitat descriptors in the bulletin for further information)

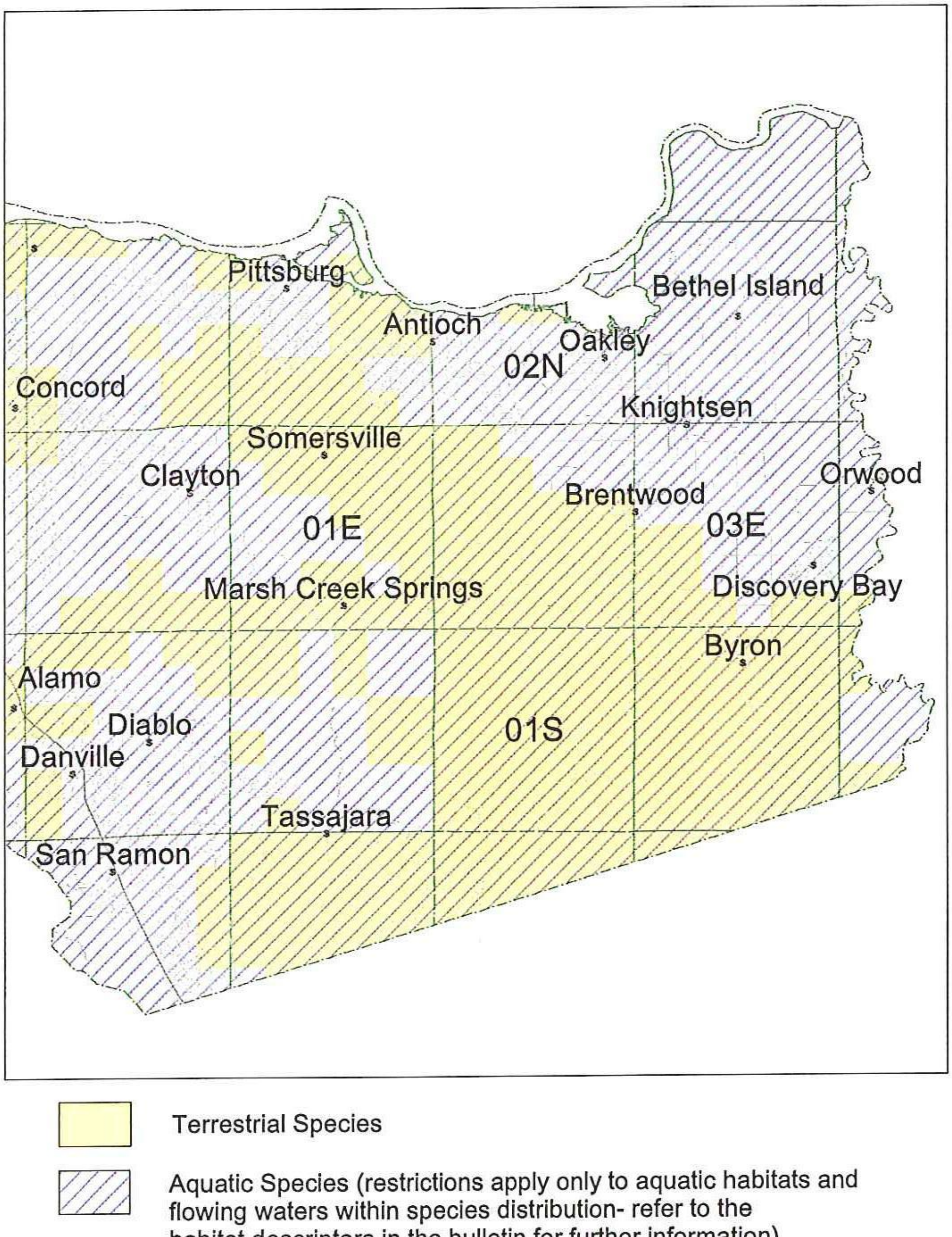
Overview Map

Distribution of Species Addressed in This Bulletin



Detail Map A

Distribution of Species Addressed in This Bulletin



Detail Map B

Worksheet for Herbicides

For each section where you will apply herbicides:

1. Is the section inside of the shaded area on the county map (p 3)? Yes ( ) No ( )
   (if yes, or if you are unsure go on to #2, if no, this bulletin does not apply)

2. Is the section listed in the Section List (p 39)? Yes ( ) No ( )
   (if yes, go on to #3, if no, this bulletin does not apply)

3. Is the active ingredient of the herbicide(s) you intend to use listed in the Active Ingredients table (p 8-11)?
   (if yes, go on to #4, if no, this bulletin does not apply) Yes ( ) No ( )

4. For each active ingredient, note the hazard class and activity category (from the Active Ingredients table).

herbicide active ingredient(s) (list each)	Hazard Class (check all that apply)			Activity Category (check one)				
	AQ	PD	PM	a	b	c	d	e
______	( )	( )	( )	( )	( )	( )	( )	( )
______	( )	( )	( )	( )	( )	( )	( )	( )
______	( )	( )	( )	( )	( )	( )	( )	( )
______	( )	( )	( )	( )	( )	( )	( )	( )
______	( )	( )	( )	( )	( )	( )	( )	( )

5. For each species in the section to be treated, look up the hazard class (taxonomic group) in the Species Descriptions table (p 32) and check all that apply.

AQ	PD	PM
( )	( )	( )

6. Does one or more hazard class(es) of the herbicide(s) from #4 match the hazard class (taxonomic group) for any of the species from #5? (if yes to any, go on to #7, if no, this bulletin does not apply) Yes ( ) No ( )

7. Look up the use limitation codes by hazard class and activity category in the Use Limitation Codes table in this section for each pesticide that you intend to use and check all use limitation codes that apply.

Limitation Codes

11 ( ) 15 ( ) 16 ( ) 17 ( ) 19 ( )

8. Follow the use limitations corresponding to each code as shown in the Use Limitations table (p 27). If more than one code applies and there is a conflict, follow the most restrictive limitation. Note that use limits apply only to sites that that match or (where buffer zones apply) are adjacent to sites that match the habitat descriptions in the Species Descriptions table (p 32) for each species.

Active Ingredients Tables

Active ingredients of pesticides covered by this bulletin are listed in separate tables on the following pages by classification as herbicides, insecticides, fungicides or rodenticides. The active ingredients table for each pesticide class specifies the activity category of each active ingredient and one or more hazard classes that are subsequently used to determine appropriate pesticide use limitations.

Herbicide Exposure Categories

Herbicides are grouped by activity categories (a-e) that broadly define mode of action and use patterns that in turn determine potential routes of exposure to listed species. The activity category of an herbicide is the exposure component that is used with the hazard class of the pesticide and the taxonomic group of the species to define which pesticide use limitations (if any) to apply.

Activity Category	Description
a	Broad spectrum foliar active herbicides with systemic or contact activity and without pre-emergent or residual soil activity.
b	Herbicides with foliar activity on broadleaved plants (dicots) only.
c	Herbicides with foliar activity on grasses (monocots) only.
d	Broad spectrum herbicides with residual soil activity.
e	Broad spectrum, seedling stage, pre-emergent herbicides.

Active Ingredients (Herbicides)

Active Ingredients	Activity Category	Hazard Class: Aquatic Animals (AQ)	Hazard Class: Plants: Dicot (PD)	Hazard Class: Plants: Monocot* (PM)
2,4-D	b		X	
2,4-D, butoxyethanol ester	b	X	X	
2,4-D, dimethylamine salt	b		X	
2-(2,4-DP), dimethylamine salt	b		X	
4(2,4-DB), dimethylamine salt	b		X	
alachlor	d		X	X
atrazine	d		X	X
benefin	e	X	X	X
bensulfuron methyl	d		X	X
bensulide	d		X	X
bentazon, sodium salt	a		X	X
bromacil	d		X	X
bromoxynil	a	X	X	X
butylate	d		X	X
cacodylic acid	a		X	X
carfentrazon-ethyl	a		X	X
chlorsulfuron	d		X	
chlorthal-dimethyl	e		X	X
clethodim	c			X
clopyralid	b		X	
copper	a	X		
copper ethanolamine complex	a	X		

* and gymnosperms

Active Ingredients (Herbicides)

Active Ingredients	Activity Category	Hazard Class: Aquatic Animals	Plants: Dicot	Plants: Monocot*
copper sulfate (basic)	a	X		
copper sulfate pentahydrate	a	X		
cyanazine	d		X	X
cycloate	d		X	X
desmedipham	e		X	X
dicamba, dimethylamine salt	b		X	
dichlobenil	d		X	X
diclofop-methyl	c	X		X
difenzoquat methyl sulfate	a			X
diquat dibromide	a		X	X
dithiopyr	d	X	X	X
diuron	d		X	X
endothall, dipotassium salt	d		X	X
endothall, mono [N,N-dimethyl alkylamine] salt	d		X	X
EPTC	d		X	X
ethafluralin	e	X	X	X
ethofumesate	d		X	X
fenoxaprop	c			X
fluazifop-butyl	c			X
glufosinate	a		X	X
halosulfuron	d		X	X
imazethapyr	d		X	X
isoxaben	d		X	X

* and gymnosperms

Active Ingredients (Herbicides)

Active Ingredients	Activity Category	Hazard Class		
			Plants	
		Aquatic Animals (AQ)	Dicot (PD)	Monocot* (PM)
glyphosate, isopropylamine salt	a		X	X
glyphosate, monoammonium salt	a		X	X
hexazinone	d		X	X
imazapyr	d		X	X
linuron	d		X	X
MCPA, dimethylamine salt	b		X	
MCPP, dimethylamine salt	b		X	
metalochlor	d		X	X
metam-sodium	d	X	X	X
metribuzin	d		X	X
molinate	d		X	X
MSMA	a		X	X
napropamide	d		X	X
nicosulfuron	a		X	X
nonanoic acid	a		X	X
norflurazon	d		X	X
oryzalin	e		X	X
oxadiazon	e	X	X	X
oxyfluorfen	e	X	X	X
paraquat dichloride	a		X	X
pebulate	e		X	X

* and gymnosperms

Active Ingredients (Herbicides)

Active Ingredients	Activity Category	Hazard Class: Aquatic Animals (AQ)	Plants: Dicot (PD)	Plants: Monocot* (PM)
pendimethalin	e	X	X	X
petroleum hydrocarbons	a		X	X
petroleum oil, unclassified	a		X	X
phenmedipham	b		X	
prometon	d		X	X
prometryn	d		X	
pronamide	d		X	X
propanil	a		X	X
pyrazon	d		X	X
pyrithiobac	b		X	
rimsulfuron	d		X	X
sethoxydim	c			X
simazine	d		X	X
sulfometuron, methyl	d		X	X
tebuthiuron	d		X	X
thiazopyr	d		X	X
thiobencarb	a		X	X
triclopyr, butoxyethyl ester	b	X	X	
triclopyr, triethylamine salt	b		X	
trifluralin	e	X	X	X

* and gymnosperms

Use Limitation Codes (Herbicides)

The following table identifies use limitation codes for each combination of hazard class (AQ, PM or PD) and herbicide activity category (a-e). Use the hazard class row(s) that corresponds with both (1) the pesticide (from the Active Ingredients table) and (2) the hazard class (taxonomic group) of the species in the section to be treated (as found in the Species Descriptions table) and the activity category column(s) that corresponds with the herbicide(s) you intend to use. If either (1) the hazard class (taxonomic group) of one or more species does not match at least one of the hazard class(es) of the herbicide you intend to use or (2) if the combination of activity category and hazard class results in a double dash (- -), then no use limitations apply. Note all applicable codes (11-19). These codes are translated in the Use Limitations table (p 27)

Hazard Class	Herbicide Activity Category				
	a	b	c	d	e
AQ	11, 17	11, 17	11, 17	11, 15, 16, 17	11, 17
PM	11, 17	- -	11, 17	11, 16, 17, 19	11
PD	11, 17	11, 17	- -	11, 16, 17, 19	11

Worksheet for Insecticides

For each section where you will apply insecticides:

1. Is the section inside of the shaded area on the county map (p 3)? Yes ( ) No ( )
   (if yes, or if you are unsure go on to #2, if no, this bulletin does not apply)

2. Is the section listed in the Section List (p 39)? Yes ( ) No ( )
   (if yes, go on to #3, if no, this bulletin does not apply)

3. Is the active ingredient of the insecticide(s) you intend to use listed in the Active Ingredients table (p 15-16)?
   (if yes, go on to #4, if no, this bulletin does not apply) Yes ( ) No ( )

4. For each active ingredient, note the hazard class and activity category (from the Active Ingredients table).

insecticide active ingredient(s) (list each)	Hazard Class (check all that apply)				Activity Category
	AQ	AV	IN	PD	i
____________	( )	( )	( )	( )	(x)
____________	( )	( )	( )	( )	(x)
____________	( )	( )	( )	( )	(x)
____________	( )	( )	( )	( )	(x)
____________	( )	( )	( )	( )	(x)

5. For each species in the section to be treated, look up the hazard class (taxonomic group) in the Species Descriptions table (p 32) and check all that apply.

AQ	AV	IN	PD
( )	( )	( )	( )

6. Does one or more toxicity class of the insecticide(s) from #4 match the hazard class (taxonomic group) for any of the species from #5? (if yes to any, go on to #7, if no, this bulletin does not apply) Yes ( ) No ( )

7. Look up the use limitation codes by hazard class and activity category in the Use Limitation Codes table in this section for each insecticide that you intend to use and check all use limitation codes that apply.

Limitation Codes

10 ( ) 15 ( ) 16 ( ) 17 ( )

8. Follow the use limitations corresponding to each code as shown in the Use Limitations table (p 27).
   If more than one code applies and there is a conflict, follow the most restrictive limitation. Note that use limits apply only to sites that that match or (where buffer zones apply) are adjacent to sites that match the habitat descriptions in the Species Descriptions table (p 32) for each species.

Activity Categories of Insecticides

There is currently only one activity category for insecticides.

Activity Category	Description
i	Insecticides applied by any method

Insecticides

Active Ingredients (Insecticides)

Active Ingredients	Activity Category	Hazard Class			
		Aquatic (AQ)	Avian (AV)	Insects (IN)	Plants-Dicot* (PD)
acephate	i			X	X
aldicarb	i	X	X		
amitraz	i	X		X	
avermectin	i	X		X	X
azinphos-methyl	i	X	X	X	X
Bacillus thuringiensis	i			X**	
bendiocarb	i	X	X	X	X
bifenthrin	i	X		X	X
buprofezin	i	X		X	X
carbaryl	i	X		X	X***
carbofuran	i	X	X	X	X
carbophenothion	i	X	X	X	X
chlorfenapyr	i	X		X	X
chlorpyrifos	i	X	X	X	X
cyfluthrin	i	X		X	X
cypermethrin	i	X		X	X
cyromazine	i			X	X
diazinon	i	X	X	X	X
dicofol	i	X	X	X	X
dicrotophos	i	X	X	X	X
diflubenzuron	i	X	X	X	
disulfoton	i	X	X	X	X
endosulfan	i	X	X	X	X
esfenvalerate	i	X		X	X
ethion	i	X		X	
ethoprop	i	X	X	X	X
fenitrothion	i	X	X	X	X

* Non-granular formulations, only when in bloom, to avoid possible adverse impacts on pollination.
** Different strains of Bacillus thuringiensis are selective for different insects. Most strains target Lepidopterous pests only. See your county agricultural commissioner for details.
*** Except XLR formulation.

Insecticides

Active Ingredients (Insecticides)

Active Ingredients	Activity Category	Hazard Class: Aquatic (AQ)	Avian (AV)	Insects (IN)	Plants-Dicot* (PD)
fenpropathrin	i	X		X	X
fenthion (livestock use)	i	X	X		
fenvalerate	i	X		X	X
fluvalinate	i	X		X	X
fonofos	i	X	X	X	X
imidacloprid	i			X	X
malathion	i	X		X	X
methamidophos	i		X	X	X
methidathion	i	X	X	X	X
methiocarb	i		X		X
methomyl	i	X	X	X	X
methyl parathion	i	X	X	X	X
mevinphos	i	X	X		X
naled	i	X		X	X
oxamyl	i	X	X	X	X
oxydemeton-methyl	i	X	X	X	X
parathion	i	X	X	X	X
permethrin	i	X		X	X
phorate	i	X	X	X	X
phosmet	i	X		X	X
profenphos	i	X		X	X
propargite	i	X		X	
pyrethrin	i	X		X	X
pyriproxyfen	i	X		X	
spinosad	i			X	X
tebufenozide	i	X		X	X
temephos	i	X	X	X	X
terbufos	i	X	X	X	X
thiodicarb (1)	i	X		X	X
tralomethrin (1)	i	X		X	X
trichlorfon (2)	i	X		X	

Use Limitation Codes for Insecticides

The following table identifies use limitation codes for each combination of toxicity class (AQ, AV or IN) and activity category (i). Use the hazard class row that corresponds with the taxonomic group(s) of species in the section to be treated. Note all applicable codes (11-17). The double dash (- -) indicates that no use limitations apply. These codes are translated in the Use Limitations table (p 27).

Hazard Class	Insecticide Activity Category
	i
AQ	10, 15, 16, 17
AV	10, 17
IN	10, 17
PD	10

Worksheet for Fungicides

For each section where you will apply fungicides:

1. Is the section inside of the shaded area on the county map (p 3)? Yes ( ) No ( )
   (if yes, or if you are unsure go on to #2, if no, this bulletin does not apply)

2. Is the section listed in the Section List (p 39)? Yes ( ) No ( )
   (if yes, go on to #3, if no, this bulletin does not apply)

3. Is the active ingredient of the fungicide(s) you intend to use listed in the Active Ingredients table (p 19)?
   (if yes, go on to #4, if no, this bulletin does not apply) Yes ( ) No ( )

4. For each active ingredient, note the hazard class and activity category (from the Active Ingredients table).

fungicide active ingredient(s) (list each)	Hazard Class	Activity Category
	AQ	f
____________	(x)	(x)
____________	(x)	(x)
____________	(x)	(x)
____________	(x)	(x)
____________	(x)	(x)

5. For each species in the section to be treated, look up the hazard class (taxonomic group) in the Species Descriptions table (p 32) and check all that apply.

   AQ
   (x)

6. Does one or more hazard class of the fungicide(s) from #4 match the hazard class (taxonomic group) for any of the species from #5? (if yes to any, go on to #7, if no, this bulletin does not apply) Yes ( ) No ( )

7. Look up the use limitation codes by hazard class and activity category in the Use Limitation Codes table in this section for each fungicide that you intend to use and check all use limitation codes that apply.

   Limitation Codes

   10 (x) 15 (x) 16 (x) 17 (x)

8. Follow the use limitations corresponding to each code as shown in the Use Limitations table (p 27). If more than one code applies and there is a conflict, follow the most restrictive limitation. Note that use limits apply only to sites that that match or (where buffer zones apply) are adjacent to sites that match the habitat descriptions in the Species Descriptions (p 32) table for each species.

Active Ingredients (Fungicides)

Active Ingredients	Activity Category	Hazard Class: Aquatic (AQ)
Azoxystrobin	f	X
Benomyl	f	X
Captan	f	X
Carboxin	f	X
Chlorothalonil	f	X
Copper	f	X
Copper Ammonium Carbonate	f	X
Copper Ammonium Complex	f	X
Copper Hydroxide	f	X
Copper Octanoate	f	X
Copper Oxychloride	f	X
Copper Oxychloride Sulfate	f	X
Copper Salts of Fatty and Rosin Acids	f	X
Copper Sulfate (Basic)	f	X
Copper Sulfate (Pentahydrate)	f	X
Dazomet	f	X
Difenoconazole	f	X
Dimethomorph	f	X
Fenbuconazole	f	X
Fludioxonil	f	X
Mancozeb	f	X
Maneb	f	X
Manganese Sulfate	f	X
Oxythioquinox	f	X
PCNB	f	X
Piperalin	f	X
Propiconazole	f	X
Tebuconazole	f	X
Thiabendazole	f	X
Thiram	f	X
Triflumizole	f	X
Ziram	f	X
Zineb	f	X

Use Limitation Codes for Fungicides

The following table identifies use limitation codes for the hazard class (AQ) and fungicide activity category (f). Note all applicable codes (10-17). These codes are translated on page 27.

Hazard Class	Fungicide Activity Category f
AQ	10, 15, 16, 17

Fungicides

Worksheet for Grain Bait Rodenticides

For each section where you will apply grain bait rodenticides:

1. Is the section inside of the shaded area on the county map (p 3)? Yes ( ) No ( )
   (if yes, or if you are unsure go on to #2, if no, this bulletin does not apply)

2. Is the section listed in the Section List (p 39)? Yes ( ) No ( )
   (if yes, go on to #3, if no, this bulletin does not apply)

3. Is the active ingredient of the pesticide(s) you intend to use listed in the Active Ingredients table (p 22)?
   (if yes, go on to #4, if no, this bulletin does not apply) Yes ( ) No ( )

4. For each active ingredient, note the hazard class and activity category (from the Active Ingredients table).

Rodenticide active ingredient(s) (list each)	Hazard Class							Activity Category		
	BB	CB	GB	HM	KF	KR	LH	g	h	k
________	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
________	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
________	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
________	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
________	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

5. For each species in the section to be treated, look up the hazard class (taxonomic group) in the Species Descriptions table (p 32) and check all that apply.

BB	CB	GB	HM	KF	KR	LH
( )	( )	( )	( )	( )	( )	( )

6. Does one or more hazard class of the pesticide(s) from #4 match the hazard class (taxonomic group) for any of the species from #5? (if yes to any, go on to #7, if no, this bulletin does not apply) Yes ( ) No ( )

7. Look up the use limitation codes by hazard class and activity category in the Use Limitation Codes table in this section for each pesticide that you intend to use and check all use limitation codes that apply.

Limitation Codes

1A ( )	1B ( )	1C ( )	1D ( )	2 ( )	3 ( )
4 ( )	7 ( )	8 ( )	33 ( )	34 ( )	

8. Follow the use limitations corresponding to each code as shown in the Use Limitations table (p 27). If more than one code applies and there is a conflict, follow the most restrictive limitation. Note that use limits apply only to sites that that match or (where buffer zones apply) are adjacent to sites that match the habitat descriptions in the Species Descriptions table (page 32) for each species.

Active Ingredients (Rodenticides)

Active Ingredients	Activity Category	Hazard Class: Bait Box (BB)	Carni-vorous Birds (CB)	Grani-vorous Birds (GB)	Salt Marsh Harvest Mouse (HM)	Kit Fox (KF)	Kangaroo Rats (KR)	Very Limited Habitat (LH)
Brodifacoum	k	X	X	X	X	X	X	X
Bromadiolone	k	X	X	X	X	X	X	X
Bromethalin	k	X	X	X	X	X	X	X
Chlorophacinone	g	X	X	X	X	X	X	X
Difenacoum	k	X	X	X	X	X	X	X
Difethialone	k	X	X	X	X	X	X	X
Diphacinone	g	X	X	X	X	X	X	X
Pival	k	X	X	X	X	X	X	X
Vitamin D3	k	X	X	X	X	X	X	X
Warfarin	k	X	X	X	X	X	X	X
Zinc Phosphide	h	X	X	X	X	X	X	X

Activity Categories of Grain Bait Rodenticides

Activity Category	Description
g	Field use chronic toxicant grain bait
h	Field use acute toxicant grain bait
k	Structural use rodenticide

Use Limitation Codes for Rodenticide Grain Baits

The following table identifies use limitation codes for each combination of hazard class (BB, CB, etc.) and rodenticide activity category (g-k). Use the row(s) that corresponds with the hazard class (taxonomic group) of the species in the section to be treated and the rodenticide activity column(s) that corresponds with the rodenticide(s) you intend to use. Note all applicable codes (1-34). The double dash (- -) indicates that no use limitations apply. These codes are translated in the Use Limitations table (p 27)

Hazard Class	Rodenticide Grain Bait Activity Category		
	g	h	k
BB	7	7	7
CB	1D	- -	7
GB	1B, 1C	1B, 1C	7
HM	7 or 34	7 or 34	7
KF	1, 2, 3, 4	3	7
KR	8	8	7
LH	33	33	33

Worksheet for Fumigant Rodenticides

For each section where you will apply fumigant rodenticides:

1. Is the section inside of the shaded area on the county map (p 3)? Yes ( ) No ( )
   (if yes, or if you are unsure go on to #2, if no, this bulletin does not apply)

2. Is the section listed in the Section List (p 39)? Yes ( ) No ( )
   (if yes, go on to #3, if no, this bulletin does not apply)

3. Is the active ingredient of the pesticide(s) you intend to use listed in the Active Ingredients table (p 25)?
   (if yes, go on to #4, if no, this bulletin does not apply) Yes ( ) No ( )

4. For each active ingredient, note the hazard class and activity category (from the Active Ingredients table).

Rodenticide active ingredient(s) (list each)	Hazard Class					Activity Category
	S1	S2	LH	WW	FS	j
__________	(x)	(x)	(x)	(x)	(x)	(x)
__________	(x)	(x)	(x)	(x)	(x)	(x)
__________	(x)	(x)	(x)	(x)	(x)	(x)
__________	(x)	(x)	(x)	(x)	(x)	(x)
__________	(x)	(x)	(x)	(x)	(x)	(x)

5. For each species in the section to be treated, look up the hazard class (taxonomic group) in the Species Descriptions table (p 32) and check all that apply.

S1	S2	LH	WW	FS
( )	( )	( )	( )	( )

6. Does one or more hazard class of the pesticide(s) from #4 match the hazard class (taxonomic group) for any of the species from #5? (if yes to any, go on to #7, if no, this bulletin does not apply) Yes ( ) No ( )

7. Look up the use limitation codes by hazard class and activity category in the Use Limitation Codes table in this section for each pesticide that you intend to use and check all use limitation codes that apply.

Limitation Codes

5 ( ) 30 ( ) 31 ( ) 32 ( ) 33 ( )

8. Follow the use limitations corresponding to each code as shown in the Use Limitations table (p 27). If more than one code applies and there is a conflict, follow the most restrictive limitation. Note that use limits apply only to sites that that match or (where buffer zones apply) are adjacent to sites that match the habitat descriptions in the Species Descriptions table (p 32) for each species.

Active Ingredients (Rodenticides - Burrow Fumigants)

Active Ingredients	Activity Category	Hazard Class				
		Seasonal Limitation 1 (S1)	Seasonal Limitation 2 (S2)	Limited Habitat (LH)	Waterways (WW)	Fossorial (Burrowing) Species (FS)
Acrolein	j	X	X	X	X	X
Aluminum phosphide	j	X	X	X	X	X
Magnesium phosphide	j	X	X	X	X	X
Sodium Nitrate	j	X	X	X	X	X
Potassium Nitrate	j	X	X	X	X	X

Activity Categories of Burrow Fumigant Rodenticides

Activity Category	Description
j	Burrow Fumigants

Use Limitation Codes for Fumigant Rodenticides

The following table identifies use limitation codes for each combination of hazard class (S1, S2, etc.) and fumigant rodenticide activity category (j). Use the hazard class row(s) that corresponds with the hazard class of the species (taxonomic group) in the section to be treated and the herbicide activity column(s) that corresponds with the fumigant(s) you intend to use. Note all applicable codes (5-32). These codes are translated in the Use Limitations table (p 27).

	Fumigant Rodenticide Activity Category
Hazard Class	j
S1	31, 5
S2	32, 5
LH	33
WW	30
FS	5

Rodenticides - Fumigants

Use Limitations

1A	**Bait station applications:** ***Formulation:*** The active ingredient shall not exceed 0.005% in the formulated bait.
1B	***Bait Station Design and Use:*** Bait stations shall be designed with an opening that prevents access to non-target species (not to exceed 3") and controls bait spillage by feeding rodents. See your county agricultural commissioner for recommended designs and suggestions to retrofit existing stations. Bait stations shall be secured (e.g. staked) upright to prevent tipping and access by non-target animals. Bait stations shall not be filled beyond design capacity and in no case shall bait stations be filled with more than 10 lbs of bait.
1C	***Station Monitoring:*** While treated baits are in use, bait stations shall be inspected for spillage, evidence of disturbance by non-target animals, excess moisture from irrigation systems, etc. Problems shall be corrected before baiting is resumed. Any spilled baits shall be promptly cleaned up (scattering limitied quantities of spilled bait in non-crop areas is acceptable if allowed by labeling). Bait stations shall be replenished with treated baits as needed to provide continuous exposure. After treated baits are accepted, as evidenced by consumption of baits, depletion of bait in the bait station shall be inspected at least weekly for depletion of bait and refilled until feeding ceases. Treated baits shall be promptly removed (or bait stations shall be sealed) from all stations after feeding has ceased. If subsequent baiting is needed, a two week period without use of treated baits shall be observed before baiting is resumed. This is to keep the period when treated bait is exposed to a minimum without jeopardizing good pest control.
1D	***Carcass Survey and Disposal:*** Carcass survey and disposal shall be performed in the treated area beginning on the third day following the initial exposure of toxic baits. Any exposed carcasses shall be disposed of (e.g., completely buried) in a manner inaccessible to wildlife. Carcass surveys shall continue for at least 5 days after toxic baiting has ceased and thereafter until no more carcasses are found. Carcasses should be handled with care to avoid contact with parasites such as fleas.
1E	***Pre-baiting (optional):*** Pre-baiting of bait stations with non-toxic (untreated) grains such as oats, oat groats or barley is optional, but may reduce the time period for carcass surveys. Pre-baiting will acclimate the pest species to feed in bait stations and should be continued until most of the target population is feeding from the stations. The period of toxic bait exposure may be shortened as will the period when pest carcasses may be exposed. The untreated grain need not be the same as the treated grain, but milo or cracked corn **should be strictly avoided** due to their attractiveness to birds.

Use Limitations

2A	**Broadcast (mechanical) and spot (hand) applications** *Formulation:* The active ingredient shall not exceed 0.01% in the formulated bait.
2B	*Test Baiting/Bait Acceptance*: Prior to the main application of toxic baits by spot or broadcast method, a small amount of the bait shall be applied to determine bait accep-tance Test baits shall be broadcast by the same method that will be used for control baiting.
2C	*Use of Treated Baits*: Use of treated baits shall begin only when bait acceptance is confirmed by consumption of test baits. Piling of baits shall be avoided. No addi-tional applications shall be made whenever significant quantities of previously applied bait remain. Do not place baits directly into burrows. Do not exceed label application rates. **Spot Baiting** - Scatter a handful of bait (about 10 handfulls per pound) evenly over 40 to 50 square feet near active burrows or runways. Repeat every other day until feeding ceases. **Mechanical Spreader** - Apply at the rate of 10 pounds per swath acre through infested area. Follow with a second application in 2 to 3 days.
2D	*Carcass Survey and Disposal:* See Limitation Code 1D.
3	Use of pelletized formulations for control of ground squirrels is prohibited, except in bait stations as described in Limitation Code 1 (A, B, C, E).
4	Jackrabbits may be controlled by using self-dispensing bait stations provided that: Bait acceptance is first determined. Carcasses are removed and stations are monitored as described in Limitation Codes 1C and 1D respectively. Baiting ceases when feeding stops. Baits are placed only where jackrabbits are active. Use of pelletized baits is prohibited.

Use Limitations

5	Use shall be supervised by a person (wildlife biologist, county agricultural commissioner, university extension advisor,state or federal official or others)who is trained to distinguish dens and burrows of target species from those of non-target species. Use shall occur only in the active burrows of target species. The person responsible for supervision shall be aware of the conditions at the site of application and be available to direct and control the manner in which applications are made (per Section 6406 of Title 3, California Code of Regulations). Contact your county agricultural commissioner for information on training.
7	For commensal rodent control, outdoor use must be in tamper resistant bait boxes placed in areas inaccessible to wildlife.
8	Use is prohibited EXCEPT under any ONE of the following conditions (in all cases where toxic baits are applied, any spilled baits shall be immediately removed or buried to prevent exposure to non-target species): For commensal rodent control, outdoor use must be in tamper resistant bait boxes placed in areas inaccessible to wildlife. An approved bait station (see yourcounty agricultural commissioner for approved designs) is used that is fitted with an entrance that provides selective access to pest species but does not allow access to kangaroo rats, OR Bait is placed only in bait stations that are elevated to preclude exposure to kangaroo rats, and designed to prevent spillage by rodents feeding (see your county agricultural commissioner for specifications), OR Baits are placed in bait stationsduring daylight hours only and are removed (or entrances are closed) by dusk each day, OR Broadcast application of baits is allowed in fields under active cultivation with the maintenance of a 10 yard wide border of untreated crops where fields are adjacent to areas of natural vegetation. For purposes of this provision, fields under active cultivation means fields that have been tilled within the last one year or that such fields are irrigated by furrow, flood or overlapping sprinkler method.
10	Do not use in currently occupied habitat (see Species Descriptions table for possible exceptions).

Use Limitations

Code	Limitation
11	Do not use in currently occupied habitat except: (1) as specified in Habitat Descriptors, (2) in organized habitat recovery programs, or (3) for selective control of invasive exotic plants.
15	Provide a 20 foot minimum strip of vegetation (on which pesticides should not be applied) along rivers, creeks, streams, wetlands, vernal pools and stock ponds or on the downhill side of fields where run-off could occur. Prepare land around fields to contain run-off by proper leveling, etc. Contain as much water "on-site" as possible. The planting of legumes, or other cover crops for several rows adjacent to off-target water sites is recommended. Mix pesticides in areas not prone to run-off such as concrete mixing/loading pads, disked soil in flat terrain or graveled mix pads, or use a suitable method to contain spills and/or rinsate. Properly empty and triple-rinse pesticide containers at time of use.
16	Conduct irrigations efficiently to prevent excessive loss of irrigation waters through run-off. Schedule irrigations and pesticide applications to maximize the interval of time between the pesticide application and the first subsequent irrigation. Allow at least 24 hours between application of pesticides listed in this bulletin and any irrigation that results in surface run-off into natural waters. Time applications to allow sprays to dry prior to rain or sprinkler irrigations. Do not make aerial applications while irrigation water is on the field unless surface run-off is contained for 72 hours following the application.
17	For sprayable or dust formulations: when the air is calm or moving away from habitat, commence applications on the side nearest the habitat and proceed away from the habitat. When air currents are moving toward habitat, do not make applications within 200 yards by air or 40 yards by ground upwind from occupied habitat. The county agricultural commissioner may reduce or waive buffer zones following a site inspection, if there is an adequate hedgerow, windbreak, riparian corridor or other physical barrier that substantially reduces the probability of drift.
19	Do not apply within 30 yards upslope of habitat unless a suitable method is used to contain or divert runoff waters.

Use Limitations

30	Use is prohibited within 500 feet of water courses at any time, EXCEPT a) in cultivated areas
31	Use is prohibited from October 1 through April 30, EXCEPT: a) in cultivated areas, or b) on the water side of water supply channels
32	Use is prohibited from July 1 through February 28, EXCEPT: a) in cultivated areas, or b) on the water side of water supply channels.
33	Use is prohibited EXCEPT with a prior site evaluation by the county agricultural commissioner in cooperation with the California Department of Fish and Game and the U.S. Fish and Wildlife Service.
34	For commensal rodent control, outdoor use near salt marshes is limited to sites that are separated by at least 10 yards of barren (or clean cultivated) ground from pickleweed habitat or from the inland side of the levee. This buffer strip should be above the high tide line.

Species Descriptions

ALAMEDA WHIPSNAKE

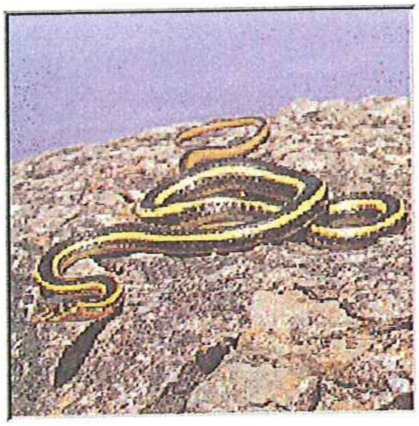


Photo: Karl H. Switak

Scientific Name: *MASTICOPHIS LATERALIS EURYXANTHUS*

Federal Status: Threatened

Species Description:

A slender, fast moving diurnal snake with a narrow neck and a relatively broad head with large eyes. The dorsal surface is colored sooty black or dark brown with a distinct yellow-orange stripe down each side. Adults reach 3-4 feet in length.

Habitat Description:

INHABITS SOUTH-FACING SLOPES AND RAVINES WHERE SHRUBS FORM A VEGETATIVE MOSAIC WITH OAK TREES AND GRASSES. RESTRICTED TO VALLEY-FOOTHILL HARDWOOD HABITAT OF THE COAST RANGES BETWEEN VIC OF MONTEREY AND N SAN FRANCISCO BAY.

Hazard Class: **FS**

CALIFORNIA CLAPPER RAIL

Photo: B. Elliot, CDFG

Scientific Name: *RALLUS LONGIROSTRIS OBSOLETUS*

Federal Status: Endangered

Species Description:

A secretive olive-brown bird with dark brown streaks, a cinnamon-colored breast, black & white bars on its flanks that stands about 14 to 16.5 inches tall with a wingspread of about 20 inches. It is compact with a short neck and long curved beak.

Habitat Description:

ASSOCIATED WITH ABUNDANT GROWTHS OF PICKLEWEED, BUT FEEDS AWAY FROM COVER ON INVERTEBRATES FROM MUD-BOTTOMED SLOUGHS. SALT-WATER & BRACKISH MARSHES TRAVERSED BY TIDAL SLOUGHS IN THE VICINITY OF SAN FRANCISCO BAY.

Hazard Class: **AQ, AV**

Species Descriptions

CALIFORNIA LEAST TERN

Photo: B. "Moose" Peterson/WRP

Scientific Name: *STERNA ANTILLARUM BROWNI (NESTING COLONY)*

Federal Status: Endangered

Species Description:

A migratory seabird present from April to September, nesting along expansive stretches of shoreline, feeds on small fish near inshore estuaries, river mouths and shallows.

Habitat Description:

COLONIAL BREEDER ON BARE OR SPARSELY VEGETATED, FLAT SUBSTRATES: SAND BEACHES, ALKALI FLATS, LAND FILLS, OR PAVED AREAS. NESTS ALONG THE COAST FROM SAN FRANCISCO BAY SOUTH TO NORTHERN BAJA CALIFORNIA.

Hazard Class: **AQ, AV**

CALIFORNIA RED-LEGGED FROG

Photo: John Brode, CDFG

Scientific Name: *RANA AURORA DRAYTONII*

Federal Status: Threatened

Species Description:

Up to 5 in. long, undersides of adults largely red; backs have black flecks and blotches, on a brown, gray, olive, or reddish background color; tadpoles range from 0.6 to 3.1 long, are dark brown and yellow with darker spots.

Habitat Description:

REQUIRES 11-20 WEEKS OF PERMANENT WATER FOR LARVAL DEVELOPMENT. MUST HAVE ACCESS TO ESTIVATION HABITAT. LOWLANDS & FOOTHILLS IN OR NEAR PERMANENT SOURCES OF DEEP WATER WITH DENSE, SHRUBBY OR EMERGENT RIPARIAN VEGETATION.

Hazard Class: **AQ, FS**

Species Descriptions

CHINOOK SALMON (SRWR-ESU)

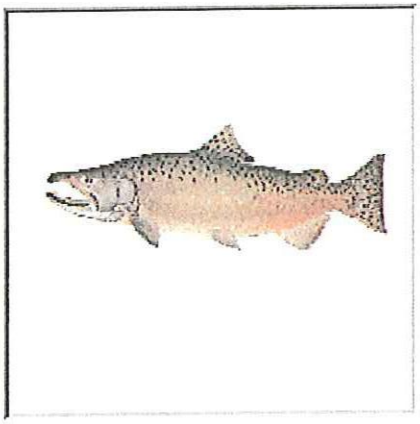


Photo: NMFS

Scientific Name: *ONCORHYNCHUS TSHAWYTSCHA*

Federal Status: Threatened

Species Description:

Chinook are largest of the salmon, adults often exceed 40 pounds. They use a variety of freshwater habitats, but it is more common to see them spawn in larger mainstem rivers than other salmon species.

Habitat Description:

OCCURS IN THE SACRAMENTO RIVER BELOW IMPASSABLE BARRIERS, ENTERS THE RIVER NOVEMBER TO JUNE AND SPAWNS FROM LATE APRIL TO MID-AUGUST.

Hazard Class: AQ

COHO SALMON (CCA-ESU)

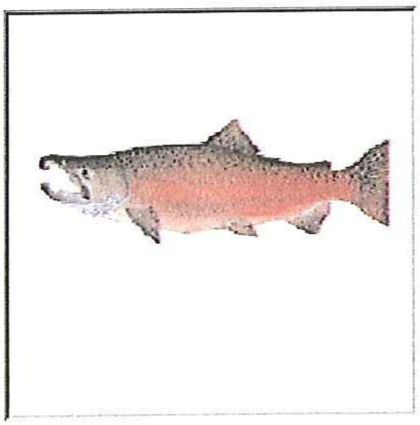


Photo: NMFS

Scientific Name: *ONCORHYNCHUS KISUTCH*

Federal Status: Threatened

Species Description:

Spawning occurs in mid-winter; eggs incubate up to 4 months; juveniles remain in freshwater up to 15 months.

Habitat Description:

Once inhabited most coastal streams in northern and central California, currently protected from the Oregon border to the San Lorenzo River (Santa Cruz Co.)

Hazard Class: AQ

Species Descriptions

CONTRA COSTA GOLDFIELDS

Photo: Brousseau Collection

Scientific Name: *LASTHENIA CONJUGENS*

Federal Status: Endangered

Species Description:

A showy spring annual that grows to 12 inches tall with leaves opposite, light green, and usually have a feather-like arrangement with narrow clefts extending more than halfway toward the stem; flowers in terminal yellow heads from March to June.

Habitat Description:

VERNAL POOLS, SWALES, LOW DEPRESSIONS, IN OPEN GRASSY AREAS. 1-445M. VALLEY AND FOOTHILL GRASSLAND, VERNAL POOLS, CISMONTANE WOODLAND. EXTIRPATED FROM MOST OF ITS RANGE; EXTREM. ENDANGERED.

Hazard Class: **PD**

GIANT GARTER SNAKE

Photo: John Brode, CDFG

Scientific Name: *THAMNOPHIS GIGAS*

Federal Status: Threatened

Species Description:

A dull brown snake with a pale dorsal stripe and black markings, attaining lengths up to 4 feet, heavy bodied with a large head, feeds in aquatic sites, often found in irrigation ditches.

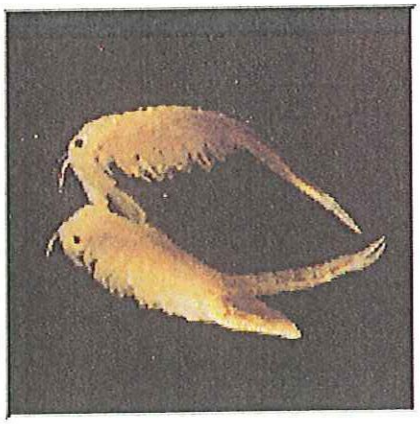
Habitat Description:

THIS IS THE MOST AQUATIC OF THE GARTER SNAKES IN CALIFORNIA. PREFERS FRESHWATER MARSH AND LOW GRADIENT STREAMS. HAS ADAPTED TO DRAINAGE CANALS & IRRIGATION DITCHES.

Hazard Class: **FS, S1**

Species Descriptions

LONGHORN FAIRY SHRIMP



Scientific Name: *BRANCHINECTA LONGIANTENNA*

Federal Status: Endangered

Species Description:

Ranges in size from 0.5 to 0.8 inches, differs from other branchinectids in that a portion of the distal segment of its antennae is flattened in the antero-posterior plane rather than the latero-medial plane.

Photo: Brent Helm, Jones & Stokes

Branchinecta sp.

Habitat Description:

INHABIT SMALL, CLEAR-WATER DEPRESSIONS IN SANDSTONE AND CLEAR-TO-TURBID CLAY/GRASS-BOTTOMED POOLS IN SHALLOW SWALES. ENDEMIC TO THE EASTERN MARGIN OF THE CENTRAL COAST MTNS IN SEASONALLY ASTATIC GRASSLAND VERNAL POOLS.

Hazard Class: AQ

SALT-MARSH HARVEST MOUSE

Scientific Name: *REITHRODONTOMYS RAVIVENTRIS*

Federal Status: Endangered

Species Description:

About the size of a house mouse, to 7 inches in length, weighing about 0.3 ounces, black and cinnamon fur with a tawny lateral stripe with blackish ears, tufts of hair at the anterior base of the ears, with distinctively calm demeanor.

Photo: B. "Moose" Peterson/WRP

Habitat Description:

PICKLEWEED IS PRIMARY HABITAT. DO NOT BURROW, BUILD LOOSELY ORGANIZED NESTS. REQUIRE HIGHER AREAS FOR FLOOD ESCAPE. ONLY IN THE SALINE EMERGENT WETLANDS OF SAN FRANCISCO BAY AND ITS TRIBUTARIES.

Hazard Class: HM

Species Descriptions

SAN JOAQUIN KIT FOX

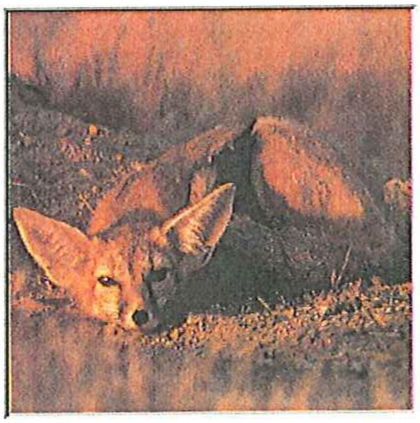


Photo: Bernard Peyton

Scientific Name: *VULPES MACROTIS MUTICA*

Federal Status: Endangered

Species Description:

Large ears, slender body to 20 in. long and 12 in. shoulder height, 12" bushy cylindrical tail tapering toward the tip, average weight 4.6 to 5.0 pounds, light buff gray pelage on back, white underneath, black tipped tail.

Habitat Description:

NEED LOOSE-TEXTURED SANDY SOILS FOR BURROWING, AND SUITABLE PREY BASE. ANNUAL GRASSLANDS OR GRASSY OPEN STAGES WITH SCATTERED SHRUBBY VEGETATION.

Hazard Class: **FS, KF**

SANTA CRUZ TARPLANT

Photo: Brousseau Collection (J. E.

Scientific Name: *HOLOCARPHA MACRADENIA*

Federal Status: Proposed Threatened

Species Description:

Aromatic annual herb with lateral and main stems 4 to 20 inches tall, lower leaves broadly linear to 5 inches long, yellow flower head surrounded from beneath by bracts that each have about 25 stout gland-tipped projections.

Habitat Description:

LIGHT, SANDY SOIL OR SANDY CLAY; OFTEN WITH NONNATIVES. 10-260M. COASTAL PRAIRIE, VALLEY AND FOOTHILL GRASSLAND.

Hazard Class: **PD**

Species Descriptions

STEELHEAD TROUT (CCV-ESU)

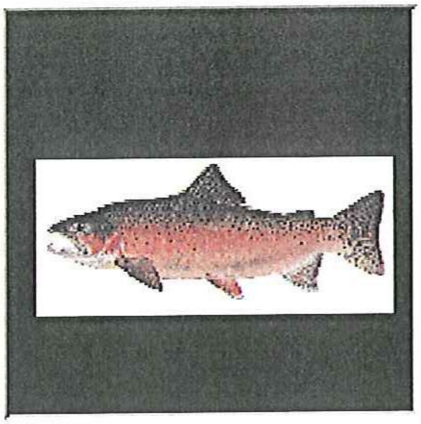


Photo: NMFS

Scientific Name: *ONCHORYNCHUS MYKISS*

Federal Status: Threatened

Species Description:

A genetically distinct and evolutionarily significant anadromous or freshwater fish related to rainbow and cutthroat trout.

Habitat Description:

COASTAL STREAMS

Hazard Class: **AQ**

STEELHEAD TROUT (SCC-ESU)

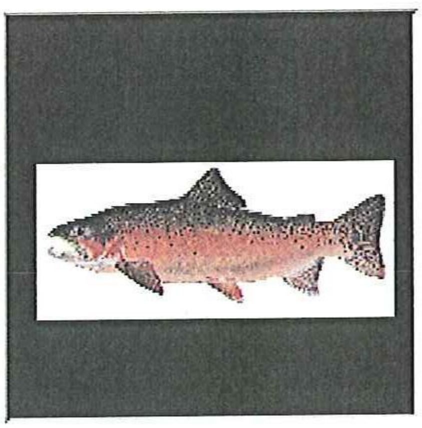


Photo: NMFS

Scientific Name: *ONCHORYNCHUS MYKISS*

Federal Status: Threatened

Species Description:

A genetically distinct and evolutionarily significant anadromous or freshwater fish related to rainbow and cutthroat trout.

Habitat Description:

COASTAL STREAMS

Hazard Class: **AQ**

Section List - Contra Costa County

Sections	Species
01N01E: S1-3	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N01E: S10	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N01E: S11-12	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N01E: S13-15	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N01E: S16	Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01N01E: S17-19	Steelhead Trout (SCC-ESU)
01N01E: S20-21	Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01N01E: S22	Steelhead Trout (CCV-ESU)
01N01E: S23-25	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N01E: S26	Steelhead Trout (CCV-ESU)
01N01E: S27-28	California Red-legged Frog, Steelhead Trout (CCV-ESU)
01N01E: S29	Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01N01E: S30	Steelhead Trout (SCC-ESU)
01N01E: S31	Alameda Whipsnake, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01N01E: S32	Alameda Whipsnake, Steelhead Trout (CCV-ESU)
01N01E: S33-35	California Red-legged Frog, Steelhead Trout (CCV-ESU)
01N01E: S36	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N01E: S4	Alameda Whipsnake, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01N01E: S5-6	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
01N01E: S7	Steelhead Trout (SCC-ESU)
01N01E: S8	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01N01E: S9	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01N01W: S1-5	Steelhead Trout (SCC-ESU)
01N01W: S27	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01N01W: S28-31	Steelhead Trout (SCC-ESU)
01N01W: S32-36	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01N01W: S6	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)
01N01W: S7-26	Steelhead Trout (SCC-ESU)
01N02E: S1-4	Steelhead Trout (CCV-ESU)
01N02E: S10-12	Steelhead Trout (CCV-ESU)
01N02E: S13-17	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N02E: S18	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N02E: S19-30	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N02E: S31	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N02E: S32-36	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N02E: S5-9	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N02W: S1	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)

Section List - Contra Costa County

Sections	Species
01N02W: S15-16	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)
01N02W: S17-20	Steelhead Trout (SCC-ESU)
01N02W: S2-6	Steelhead Trout (SCC-ESU)
01N02W: S21-23	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)
01N02W: S24-25	Steelhead Trout (SCC-ESU)
01N02W: S26-28	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)
01N02W: S29-33	Steelhead Trout (SCC-ESU)
01N02W: S34-35	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01N02W: S36	Steelhead Trout (SCC-ESU)
01N02W: S7	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01N02W: S8-14	Steelhead Trout (SCC-ESU)
01N03E: S1-18	Steelhead Trout (CCV-ESU)
01N03E: S19-20	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N03E: S21-28	Steelhead Trout (CCV-ESU)
01N03E: S29-33	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N03E: S34	Steelhead Trout (CCV-ESU)
01N03E: S35-36	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N03W: S1-4	Steelhead Trout (SCC-ESU)
01N03W: S12	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01N03W: S13-16	Steelhead Trout (SCC-ESU)
01N03W: S17	Santa Cruz Tarplant, Steelhead Trout (SCC-ESU)
01N03W: S18-20	Chinook Salmon (SRWR-ESU), Santa Cruz Tarplant, Steelhead Trout (SCC-ESU)
01N03W: S21	Alameda Whipsnake, Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
01N03W: S22-27	Steelhead Trout (SCC-ESU)
01N03W: S28-30	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
01N03W: S31	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01N03W: S32	Steelhead Trout (SCC-ESU)
01N03W: S33-34	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01N03W: S35-36	Steelhead Trout (SCC-ESU)
01N03W: S5-8	Santa Cruz Tarplant, Steelhead Trout (SCC-ESU)
01N03W: S9-11	Steelhead Trout (SCC-ESU)
01N04E: S31	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01N04E: S32	Steelhead Trout (CCV-ESU)
01N04E: S5-8,17-20,29-30	Steelhead Trout (CCV-ESU)
01N04W: S1	Chinook Salmon (SRWR-ESU), Santa Cruz Tarplant, Steelhead Trout (SCC-ESU)
01N04W: S16-17	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)

Section List - Contra Costa County

Sections	Species
01N04W: S18	Steelhead Trout (SCC-ESU)
01N04W: S19	California Clapper Rail, Coho Salmon (CCA-ESU), Steelhead Trout (SCC-ESU)
01N04W: S2-8	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
01N04W: S20	California Clapper Rail, Steelhead Trout (SCC-ESU)
01N04W: S21-22	Steelhead Trout (SCC-ESU)
01N04W: S23-25	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
01N04W: S26-27	Steelhead Trout (SCC-ESU)
01N04W: S28	Coho Salmon (CCA-ESU), Steelhead Trout (SCC-ESU)
01N04W: S29-30	California Clapper Rail, Chinook Salmon (SRWR-ESU), Coho Salmon (CCA-ESU), Steelhead Trout (SCC-ESU)
01N04W: S31-32	Chinook Salmon (SRWR-ESU), Coho Salmon (CCA-ESU), Steelhead Trout (SCC-ESU)
01N04W: S36	Steelhead Trout (SCC-ESU)
01N04W: S9-15	Chinook Salmon (SRWR-ESU), Santa Cruz Tarplant, Steelhead Trout (SCC-ESU)
01N05W: S1	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
01N05W: S10-11	California Clapper Rail, Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
01N05W: S12	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
01N05W: S13	Steelhead Trout (SCC-ESU)
01N05W: S14	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
01N05W: S15-17,21-27,34-36	Chinook Salmon (SRWR-ESU), Coho Salmon (CCA-ESU), Steelhead Trout (SCC-ESU)
01N05W: S2-3	California Clapper Rail, Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
01N05W: S4-5,8-9	Chinook Salmon (SRWR-ESU), Coho Salmon (CCA-ESU), Steelhead Trout (SCC-ESU)
01S01E: S1-2	Steelhead Trout (CCV-ESU)
01S01E: S10	California Red-legged Frog, Steelhead Trout (CCV-ESU)
01S01E: S11-12	Steelhead Trout (CCV-ESU)
01S01E: S13	Alameda Whipsnake, California Red-legged Frog, Steelhead Trout (CCV-ESU)
01S01E: S14	California Red-legged Frog, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01S01E: S15	Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01S01E: S16-18	Steelhead Trout (SCC-ESU)
01S01E: S19	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S01E: S20-22	Steelhead Trout (SCC-ESU)
01S01E: S23	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01S01E: S24	California Red-legged Frog, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)

Section List - Contra Costa County

Sections	Species
01S01E: S25-31	Steelhead Trout (SCC-ESU)
01S01E: S3	California Red-legged Frog, Steelhead Trout (CCV-ESU)
01S01E: S32	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01S01E: S33-36	Steelhead Trout (SCC-ESU)
01S01E: S4	Steelhead Trout (CCV-ESU)
01S01E: S5-8	Alameda Whipsnake, Steelhead Trout (CCV-ESU)
01S01E: S9	Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01S01W: S1-2	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S01W: S12	Alameda Whipsnake, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
01S01W: S13-16	Steelhead Trout (SCC-ESU)
01S01W: S17-18	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S01W: S19-29	Steelhead Trout (SCC-ESU)
01S01W: S3	Steelhead Trout (SCC-ESU)
01S01W: S30-31	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S01W: S32-36	Steelhead Trout (SCC-ESU)
01S01W: S4	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S01W: S5	Alameda Whipsnake, California Red-legged Frog, Steelhead Trout (SCC-ESU)
01S01W: S6	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01S01W: S7-11	Steelhead Trout (SCC-ESU)
01S02E: S1-3	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S10-12	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S13-14	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S15-16	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S17	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S18	Alameda Whipsnake, California Red-legged Frog, Steelhead Trout (CCV-ESU)
01S02E: S19-20	California Red-legged Frog, Steelhead Trout (CCV-ESU)
01S02E: S21	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S22	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S23-24	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S25	California Red-legged Frog, Longhorn Fairy Shrimp, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S26	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S27	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S28	Alameda Whipsnake, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S29	Alameda Whipsnake, California Red-legged Frog, Steelhead Trout (CCV-ESU)
01S02E: S30	Alameda Whipsnake, California Red-legged Frog, Steelhead Trout (SCC-ESU)
01S02E: S31	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01S02E: S32	Alameda Whipsnake, California Red-legged Frog, Steelhead Trout (SCC-ESU)

Section List - Contra Costa County

Sections	Species
01S02E: S33	Alameda Whipsnake, Steelhead Trout (CCV-ESU)
01S02E: S34	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S35	Longhorn Fairy Shrimp, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S36	California Red-legged Frog, Longhorn Fairy Shrimp, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S4-5	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S6-7	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02E: S8-9	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S02W: S1	Steelhead Trout (SCC-ESU)
01S02W: S11-14	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S02W: S15-26	Steelhead Trout (SCC-ESU)
01S02W: S2-3	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S02W: S27	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S02W: S28-32	Steelhead Trout (SCC-ESU)
01S02W: S33-34	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S02W: S35-36	Steelhead Trout (SCC-ESU)
01S02W: S4-7	Steelhead Trout (SCC-ESU)
01S02W: S8	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01S02W: S9-10	Steelhead Trout (SCC-ESU)
01S03E: S1-6	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S10	Contra Costa Goldfields, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S11-14	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S15	Contra Costa Goldfields, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S16-17	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S18	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S19-22	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S23-28	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S29	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S30-31	California Red-legged Frog, Longhorn Fairy Shrimp, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S32-34	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S35	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S36	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S7	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03E: S8-9	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S03W: S1-2	Steelhead Trout (SCC-ESU)
01S03W: S10	California Red-legged Frog, Steelhead Trout (SCC-ESU)
01S03W: S11-14	Steelhead Trout (SCC-ESU)
01S03W: S15	Alameda Whipsnake, Steelhead Trout (SCC-ESU)

Section List - Contra Costa County

Sections	Species
01S03W: S16,22-27,36	Steelhead Trout (SCC-ESU)
01S03W: S3-6,8	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
01S03W: S9	Steelhead Trout (SCC-ESU)
01S04E: S29-30	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S04E: S6-7	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
01S04E: S8-9,16-21	Steelhead Trout (CCV-ESU)
02N01E: S10-11	Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N01E: S13	Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (CCV-ESU)
02N01E: S14-15	Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N01E: S16-18	Steelhead Trout (SCC-ESU)
02N01E: S19	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02N01E: S2	Chinook Salmon (SRWR-ESU)
02N01E: S20-21	Steelhead Trout (SCC-ESU)
02N01E: S22	Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N01E: S23	Salt-marsh Harvest Mouse, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
02N01E: S24	Salt-marsh Harvest Mouse, Steelhead Trout (CCV-ESU)
02N01E: S25-26	Steelhead Trout (CCV-ESU)
02N01E: S27	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
02N01E: S28-30	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02N01E: S3-5	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N01E: S31	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02N01E: S32	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02N01E: S33	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
02N01E: S34-35	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
02N01E: S36	Steelhead Trout (CCV-ESU)
02N01E: S6	California Least Tern, Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N01E: S7	California Least Tern, Steelhead Trout (SCC-ESU)
02N01E: S8-9	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N01W: S1	California Least Tern, Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N01W: S12	California Least Tern, Steelhead Trout (SCC-ESU)
02N01W: S13-21	Steelhead Trout (SCC-ESU)
02N01W: S2-3	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)

Section List - Contra Costa County

Sections	Species
02N01W: S22	California Red-legged Frog, Steelhead Trout (SCC-ESU)
02N01W: S23	Steelhead Trout (SCC-ESU)
02N01W: S24-25	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02N01W: S26	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02N01W: S27-29	Steelhead Trout (SCC-ESU)
02N01W: S30-31	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)
02N01W: S32-34	Steelhead Trout (SCC-ESU)
02N01W: S35	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02N01W: S36	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02N01W: S4	California Least Tern, Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N01W: S5	California Least Tern, Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N01W: S6	California Clapper Rail, Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N01W: S7-11	Steelhead Trout (SCC-ESU)
02N02E: S1,10	Chinook Salmon (SRWR-ESU)
02N02E: S11-14	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
02N02E: S15-16	Chinook Salmon (SRWR-ESU), Giant Garter Snake, Steelhead Trout (CCV-ESU)
02N02E: S17-18	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
02N02E: S19-22	Steelhead Trout (CCV-ESU)
02N02E: S23-24	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
02N02E: S25-36	Steelhead Trout (CCV-ESU)
02N02W: S1-5,7-9	Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N02W: S10-12	Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N02W: S13-14	Steelhead Trout (SCC-ESU)
02N02W: S15-17	Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N02W: S18-24	Steelhead Trout (SCC-ESU)
02N02W: S25	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)
02N02W: S26-34	Steelhead Trout (SCC-ESU)
02N02W: S35-36	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)
02N03E: S1-5	Steelhead Trout (CCV-ESU)
02N03E: S18-19	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
02N03E: S20-36	Steelhead Trout (CCV-ESU)
02N03E: S6-7	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
02N03E: S8-17	Steelhead Trout (CCV-ESU)
02N03W: S10-13	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)

Section List - Contra Costa County

Sections	Species
02N03W: S14-17	Steelhead Trout (SCC-ESU)
02N03W: S18	Contra Costa Goldfields, Steelhead Trout (SCC-ESU)
02N03W: S19-30	Steelhead Trout (SCC-ESU)
02N03W: S2-6	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N03W: S31	California Red-legged Frog, Steelhead Trout (SCC-ESU)
02N03W: S32	Steelhead Trout (SCC-ESU)
02N03W: S33	Alameda Whipsnake, Steelhead Trout (SCC-ESU)
02N03W: S34-36	Steelhead Trout (SCC-ESU)
02N03W: S7-9	Steelhead Trout (SCC-ESU)
02N04E: S6-8,17-20,30-31	Steelhead Trout (CCV-ESU)
02N04W: S1-11	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N04W: S12-14	Steelhead Trout (SCC-ESU)
02N04W: S15-21	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N04W: S22-28	Steelhead Trout (SCC-ESU)
02N04W: S29-34	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N04W: S35	Chinook Salmon (SRWR-ESU), Santa Cruz Tarplant, Steelhead Trout (SCC-ESU)
02N04W: S36	Steelhead Trout (SCC-ESU)
02N05W: S1-2,10-15,21-24	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N05W: S25	California Clapper Rail, Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02N05W: S26-29	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N05W: S32	Chinook Salmon (SRWR-ESU), Coho Salmon (CCA-ESU), Steelhead Trout (SCC-ESU)
02N05W: S33-34	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
02N05W: S35-36	California Clapper Rail, Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
02S01E: S1-4	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01E: S11-15	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01E: S16	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01E: S17-20	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01E: S21-22	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01E: S23-24,29	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01E: S30	Steelhead Trout (SCC-ESU)
02S01E: S5	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01E: S6-8	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01E: S9-10	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01W: S1-11	Steelhead Trout (SCC-ESU)
02S01W: S12-13	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)

Section List - Contra Costa County

Sections	Species
02S01W: S14-23	Steelhead Trout (SCC-ESU)
02S01W: S24	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S01W: S25-29,34-35	Steelhead Trout (SCC-ESU)
02S02E: S1	Longhorn Fairy Shrimp, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
02S02E: S10	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
02S02E: S11-12	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
02S02E: S16	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S02E: S17	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S02E: S18	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S02E: S2	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
02S02E: S3	California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
02S02E: S4	California Red-legged Frog, Steelhead Trout (CCV-ESU), Steelhead Trout (SCC-ESU)
02S02E: S5	Alameda Whipsnake, California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S02E: S6-7	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S02E: S8	Alameda Whipsnake, California Red-legged Frog, San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S02E: S9	San Joaquin Kit Fox, Steelhead Trout (SCC-ESU)
02S02W: S1	Steelhead Trout (SCC-ESU)
02S03E: S4-5	San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
02S03E: S6	Longhorn Fairy Shrimp, San Joaquin Kit Fox, Steelhead Trout (CCV-ESU)
03N01E: S33-34	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
03N01W: S31	California Clapper Rail, Chinook Salmon (SRWR-ESU), Salt-marsh Harvest Mouse, Steelhead Trout (SCC-ESU)
03N01W: S32-34	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
03N02W: S34-36	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
03N03E: S13-15	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
03N03E: S17	Chinook Salmon (SRWR-ESU)
03N03E: S19-25	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
03N03E: S26-28	Steelhead Trout (CCV-ESU)
03N03E: S29-31	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
03N03E: S32-36	Steelhead Trout (CCV-ESU)
03N03W: S31-34	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
03N04E: S19-20,29-32	Chinook Salmon (SRWR-ESU), Steelhead Trout (CCV-ESU)
03N04W: S31-36	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)
03N05W: S36	Chinook Salmon (SRWR-ESU), Steelhead Trout (SCC-ESU)