SAN JOAQUIN RIVER
RESTORATION PROGRAM

Water Year 2010 Interim Flows Project

Biological Assessment




May 22, 2009

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List of Abbreviations and Acronyms

°F	degrees Fahrenheit
Act	San Joaquin River Restoration Settlement Act
AFRP	Anadromous Fish Restoration Program
BA	Biological Assessment
Banks	CVP – Harvey O. Banks Pumping Plant
BNLL	blunt-nosed leopard lizard
BO	biological opinion
CCID	Central California Irrigation District
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
COA	Coordinated Operation of the CVP and SWP
CVP	Central Valley Project
CWA	Clean Water Act
D-1485	SWRCB Decision 1485
DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin Delta
DMC	Delta-Mendota Canal
DO	dissolved oxygen
DPS	distinct population segment
DWR	California Department of Water Resources
DWSC	Deep Water Ship Channel
ECPWG	Environmental Compliance Permitting and Work Group
EFH	essential fish habitat
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FMWG	Fisheries Management Work Group
FR	Federal Register
HCP	habitat conservation plans
IWM	instream woody material
Jones	SWP – C. W. “Bill” Jones Pumping Plant
LSZ	low-salinity zone
NMFS	National Marine Fisheries Service
NRDC	Natural Resources Defense Council

NWR	National Wildlife Refuge
PCB	polychlorinated biphenyl
PCE	Primary Constituent Element
PFMC	Pacific Fishery Management Council
ppt	parts per thousand
RA	Restoration Administrator
RBDD	Red Bluff Diversion Dam
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RPA	Reasonable and prudent Alternative
RWQCB	Regional Water Quality Control Boards
SJRRP	San Joaquin River Restoration Program
SJVAPCD	San Joaquin Valley Air Pollution Control District
SLDMWA	San Luis Delta Mendota Water Authority
SWP	State Water Project
SWRCB	California State Water Resources Control Board
USACE	United States Army Corps of Engineers
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service
VAMP	Vernalis Adaptive Management Program
WRPC	Watershed Restoration and Protection Council
WY 2010	Water Year 2010
YOY	young-of-the-year

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1.0 Introduction

The San Joaquin River Restoration Program (SJRRP) was established in late 2006 to implement the Stipulation of Settlement in *NRDC et al. v. Kirk Rodgers et al*. (Settlement). Authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Act: Public Law 111-11). The U.S. Department of the Interior, Bureau of Reclamation (Reclamation), as the Federal lead agency is preparing this Biological Assessment in compliance with Section 7 of the Federal Endangered Species Act.

1.1 Project Summary

Reclamation is proposing to temporarily change Friant Dam operations in Water Year 2010 (WY 2010) (October 1, 2009, through September 30, 2010) to release WY 2010 Interim Flows from Friant Dam into the San Joaquin River and potentially downstream as far as the Sacramento-San Joaquin Delta (Delta), as specified in the Act, and reoperation of Friant Dam is part of the SJRRP established under the Settlement. A portion or all of the WY 2010 Interim Flows would be recaptured by existing water diversion facilities along the San Joaquin River and/or in the Delta for agricultural, municipal and industrial, and/or fish and wildlife uses. Potential diversion locations for recapturing releases of Interim Flows during WY 2010 are Mendota Pool, Arroyo Canal, the Lone Tree Unit of the Merced National Wildlife Refuge (NWR), the East Bear Creek Unit of the San Luis NWR Complex, and Central Valley Project (CVP) and State Water Project (SWP) Delta export facilities. The action would involve no construction activities.

The purpose of the Proposed Action is to implement the provisions of the Settlement pertaining to WY 2010. The need for action is specified in the Settlement, which requires Interim Flows to be released in WY 2010. The action is needed to support collection of relevant data to guide future releases of Interim Flows and Restoration Flows under the SJRRP. Other environmental conservation measures to avoid adverse effects on suitable habitat for the listed plant and wildlife species potentially affected by the Proposed Action (e.g., managing nonnative vegetation, avoiding sensitive habitats, and conducting focused surveys) are also proposed by Reclamation as part of the WY 2010 Interim Flows.

1.2 Purpose

The purpose of this Biological Assessment (BA) is to review the WY 2010 Interim Flows in detail sufficient to determine the extent to which implementing the Proposed Action may affect any Federally listed or proposed for listing as threatened or endangered species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). This BA has been prepared in accordance with requirements set forth under Section 7 of the Federal Endangered Species Act (ESA) (16 U.S. Code (USC) 1536(c)), described below.

1.2.1 Regulatory Framework

Under provisions of Section 7(a)(2) of the ESA, a Federal agency that permits, licenses, funds, or otherwise authorizes activities must consult with USFWS and NMFS, as appropriate, to ensure that its action will not jeopardize the continued existence of any listed species or adversely modify critical habitat (16 USC 1536(c)). A Federal agency is required to consult if an action "may affect" listed species or designated critical habitat. The term "biological assessment" refers to the information prepared by, or under the direction of, the Federal agency concerning listed and proposed species and designated and proposed critical habitat that may be present in the Action Area, and the evaluation of the potential effects of the action on those species and habitat (50 Code of Federal Regulations (CFR) Section 402.2). A BA must be prepared if listed species or critical habitat may be present in an area to be affected by a "major construction activity." When a Federal agency determines, through a BA or other review, that its action is "likely to adversely affect" a listed species or designated critical habitat, the agency must submit a request for formal consultation to USFWS and NMFS if the Federal action would adversely affect listed anadromous fish species. There is a designated period of time (90 days) for this consultation to take place and, after that, another set period of time (45 days) for USFWS and NMFS to prepare Biological Opinions (BO). The BOs present USFWS's and NMFS's determinations as to whether or not the Proposed Action would be likely jeopardize the species or adversely modify its critical habitat. If a "jeopardy" or "adverse modification" determination is made, the BO must identify any reasonable and prudent alternative actions that could satisfy the purpose and need for the action.

If USFWS and NMFS issue either a "nonjeopardy" opinion or a "jeopardy" opinion that contains reasonable and prudent alternatives, the opinion may include an incidental take statement. USFWS and NMFS must anticipate the quantity of take that may result from the Proposed Action and authorize such take with a statement that the listed species described in the incidental take statement will not be jeopardized. The incidental take statement must contain clear terms and conditions designed to reduce the impact of the anticipated take; these terms are binding on the action agency.

In addition to compliance with ESA, Reclamation is required to comply with the Magnuson-Stevens Fishery Conservation and Management Act. The purpose of this act is for Federal agencies to take immediate action to conserve and manage the fishery resources found off the coasts of the United States, and the nation's anadromous species and continental shelf fishery resources. Consultation with NMFS is required when any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, may adversely affect any essential fish habitat (EFH). Within the Action Area, EFH is found only in the Delta and in the three main San Joaquin River tributaries (Merced, Tuolumne and Merced rivers). This BA incorporates an assessment of EFH to provide NMFS with the opportunity to include an EFH determination in the BO.

1.2.2 Proposed Action

The Proposed Action is to increase the release of water from Friant Dam for one year (WY 2010) in accordance with the Settlement and in a manner consistent with Federal, State, and, local laws, and future agreements with downstream agencies, entities, and landowners. The activities, and the related environmental commitment measures, of the Proposed Action are described in Chapter 3 of this BA. The Proposed Action would release Interim Flows to the San Joaquin River from Friant Dam during WY 2010, from October 1, 2009, through November 20, 2009, and from February 1, 2010, through September 30, 2010, in accordance with the flow schedule presented in Exhibit B of the Settlement. WY 2010 Interim Flows would be reduced or diverted as needed to avoid causing substantial adverse conditions in downstream reaches, as specified in environmental commitments. The Proposed Action involves recapturing WY 2010 Interim Flows at locations along the San Joaquin River, in the Delta, or both to the maximum extent possible, and transferring this water back to the Friant Division Long-Term Contractors. The maximum downstream extent of WY 2010 Interim Flows that could be recaptured would be at the CVP Harvey O. Banks Pumping Plant (Banks) and the SWP C. W. “Bill” Jones Pumping Plant (Jones) in the Delta.

This BA analyzes direct, indirect, interrelated/interdependent, and cumulative effects of Reclamation’s Proposed Action on Federally proposed and listed species considered in the assessment. This BA will be used by USFWS and NMFS to analyze the Proposed Action for Section 7 consultation on the WY 2010 Interim Flows.

1.3 Action Area

The Action Area is defined as all areas to be affected directly or indirectly by the Federal action, not strictly the immediate area involved in the action (USFWS and NMFS 1998). The Action Area includes all areas where flows and water levels could be altered as a result of the release of WY 2010 Interim Flows under the SJRRP (see Figure 1-1, “Action Area”). Specifically, the Action Area covers the following areas:

- Millerton Lake and the San Joaquin River between Kerkhoff Dam and Millerton Lake
- San Joaquin River from Friant Dam downstream to the Delta
- Eastside Bypass, downstream from the Sand Slough Control Structure, and the Mariposa Bypass
- Merced, Tuolumne, and Stanislaus rivers downstream from New Exchequer, Don Pedro, and New Melones dams, respectively
- South and central Delta, defined as the San Joaquin River and its tributaries within the Delta west to its confluence with the Sacramento River

1.4 Species Evaluated

This document evaluates threatened, endangered, proposed threatened, or proposed endangered species under the jurisdiction of USFWS and NMFS that have potential to be affected by the Proposed Action, as well as any designated or proposed critical habitat. A preliminary list of species for consideration was requested from NMFS (Appendix A) and compiled from official species lists maintained and USFWS (Appendix B) that encompass the Action Area.

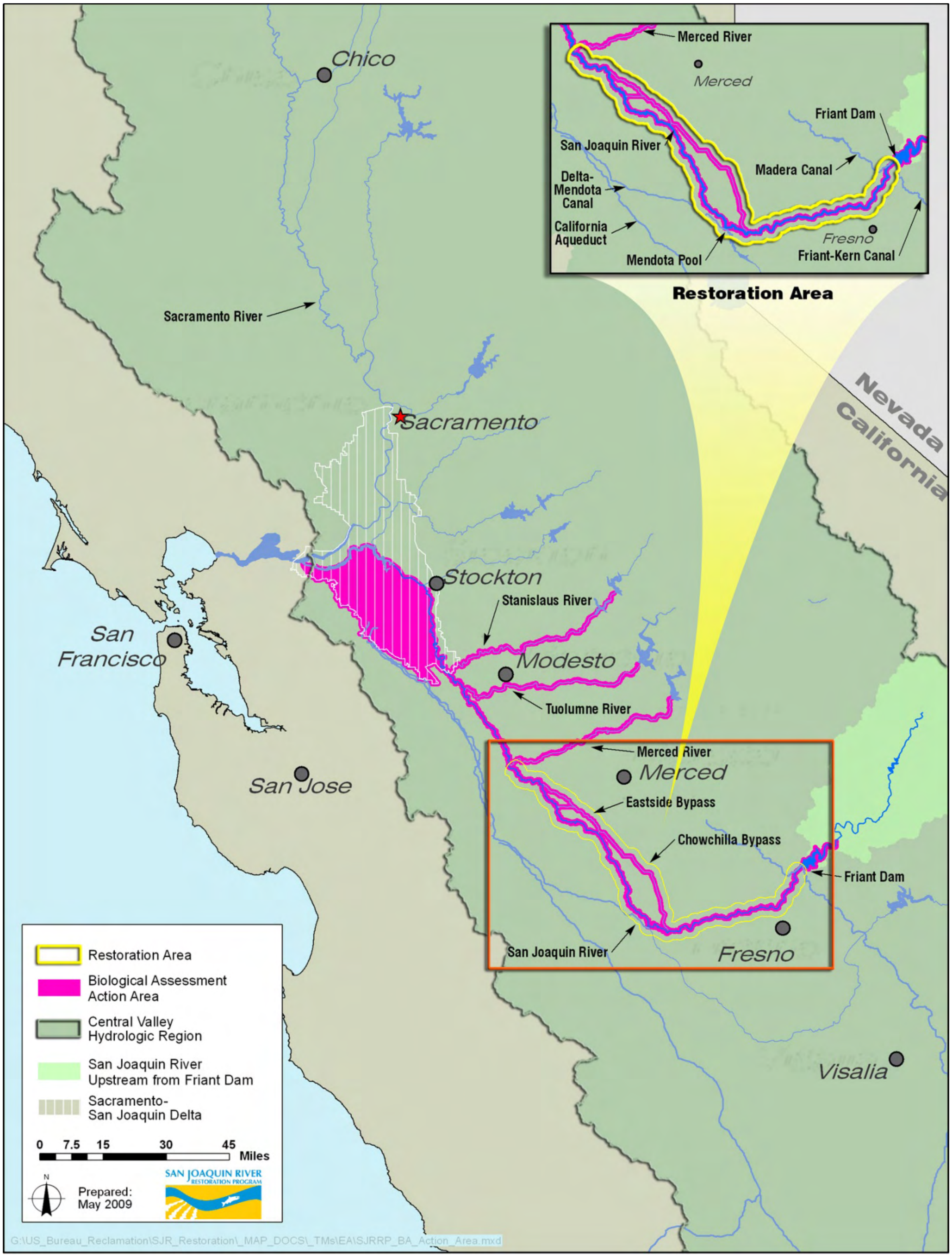


Figure 1-1.
Action Area for the Water Year 2010 Interim Flows

1.4.1 Species Included in the Analysis

Tables 1-1, 1-2, and 1-3 identify the Federally listed fish, plant, and wildlife species that are addressed in this BA.

Table 1-1.
Federally Listed Fish Species That May be Affected by WY 2010 Interim Flows

Species	Federal Status	Critical Habitat
North American green sturgeon *Acipenser medirostris*	T	Proposed critical habitat in the Action Area (73 *Federal Register* 52084–52110, September 8, 2008).
Delta smelt *Hypomesus transpacificus*	T	Designated critical habitat in the Action Area (59 *Federal Register* 65256–65279, December 19, 1994).
Central Valley steelhead distinct population segment (DPS) *Oncorhynchus mykiss*	T	Designated critical habitat in the Action Area (70 *Federal Register* 52488–52536, September 2, 2005).
Central Valley spring-run Chinook salmon evolutionarily significant unit (ESU) *Oncorhynchus tshawytscha*	T	Designated critical habitat not within the Action Area (70 *Federal Register* 52488–52536, September 2, 2005).
Sacramento River winter-run Chinook salmon ESU *Oncorhynchus tshawytscha*	E	Designated critical habitat not within the Action Area (58 *Federal Register* 33212–33219, June 16, 1993).

Notes:
U.S. Fish and Wildlife Service Federal and National Marine Fisheries Service Listing Categories:
E = Federally listed as endangered
T = Federally listed as threatened

Table 1-2.
Federally Listed Plant Species That May be Affected by WY 2010 Interim Flows

Species	Federal Status	Critical Habitat	Habitat Association
Succulent owl's-clover *Castilleja campestris* ssp. *succulenta*	T	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999).	Northern claypan and northern hardpan vernal pools on alluvial terraces or northern basalt flow vernal pools, often acidic soils; 160–2,500 feet elevation.
Hoover's spurge *Chamaesyce hooveri*	T	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999).	Relatively deep, northern hardpan and northern claypan vernal pools on alluvial fans or terraces of ancient rivers or streams; neutral to saline-alkaline soils over lime-silica cemented hardpan or claypan in the San Joaquin Valley or acidic soils over iron-silica cemented hardpan in the Sacramento Valley; usually in areas devoid of competing vegetation; 80–820 feet elevation.
Palmate-bracted bird's-beak *Cordylanthus palmatus*	E	None designated.	Alkaline soils in chenopod scrub and valley and foothill grassland; 15–500 feet elevation.
Colusa grass *Neostapfia colusana*	T	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999, August 11, 2005).	Large, relatively deep northern claypan and northern hardpan vernal pools on the rim of alkaline basins or acidic soils of alluvial fans and stream terraces; lime-silica cemented hardpan in the San Joaquin Valley basins to iron-silica cemented hardpan in eastern margin of the San Joaquin Valley; 15–4,000 feet elevation.
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	T	Designated critical habitat adjacent to the Action Area (70 *Federal Register* 46924–46999, August 11, 2005).	Northern claypan, northern hardpan, and northern basalt flow vernal pools on alluvial fans, high and low stream terraces, and tabletop lava flows; acidic soils over iron-silica cemented hardpan, tuffaceous alluvium, and basaltic rock from ancient volcanic flows; 30–2,500 feet elevation
Hairy Orcutt grass *Orcuttia pilosa*	E	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999, August 11, 2005).	Northern hardpan and northern claypan vernal pools on high or low stream terraces and alluvial fans; found on both acidic and saline-alkaline soils with iron-silica cemented hardpan or claypan; 175–650 feet elevation.
Greene's tuctoria *Tuctoria greenei*	E	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999, August 11, 2005).	Northern basalt flow, northern claypan, and northern hardpan vernal pools underlain by iron-silica cemented hardpan, tuffaceous alluvium, or claypan; 110–3,500 feet elevation.

Source: USFWS 2009
Notes:
U.S. Fish and Wildlife Service Federal Listing Categories:
E = Federally listed as endangered
T = Federally listed as threatened

Table 1-3.
Federally Listed Wildlife Species That May be Affected by WY 2010 Interim Flows

Common Name	Federal Status	Critical Habitat	Habitat Association
Invertebrates			
Conservancy fairy shrimp *Branchinecta conservatio*	E	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999, August 11, 2005).	Vernal pools and swales.
Longhorn fairy shrimp *Branchinecta longiantenna*	E	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999, August 11, 2005).	Vernal pools and swales.
Vernal pool fairy shrimp *Branchinecta lynchi*	T	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999, August 11, 2005).	Vernal pools and other seasonal wetlands.
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	No designated critical habitat in the Action Area (45 *Federal Register* 52803–52807, August 10, 1980).	Elderberry shrubs, typically in riparian habitats.
Vernal pool tadpole shrimp *Lepidurus packardi*	E	Designated critical habitat in the Action Area (70 *Federal Register* 46924–46999, August 11, 2005).	Vernal pools, swales, and other ephemeral wetlands.
Amphibians			
California tiger salamander *Ambystoma californiense*	T	Designated critical habitat in the Action Area (70 *Federal Register* 49379–49458, August 23, 2005).	Small ponds, lakes, or vernal pools in grasslands or oak woodlands.
Reptiles			
Blunt-nosed leopard lizard *Gambelia sila*	E	None designated.	Open habitats with scattered low bushes on alkali flats, plains, washes, and arroyos.
Giant garter snake *Thamnophis gigas*	T	None designated.	Streams, sloughs, ponds, and irrigation/drainage ditches; also requires upland refugia not subject to flooding during its inactive season.

Table 1-3.
Federally Listed Wildlife Species That May be Affected by WY 2010 Interim Flows (contd.)

Common Name	Federal Status	Critical Habitat	Habitat Association
Birds			
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	C	None designated.	Inhabits wide, dense riparian forests with a thick understory of willows for nesting; prefers sites with a dominant cottonwood overstory for foraging.
Least Bell's vireo *Vireo bellii pusillus*	E	No designated critical habitat in the Action Area (59 *Federal Register* 4845–4867, February 2, 1994).	Cottonwood-willow forest, oak woodland, shrubby thickets, and dry washes with willow thickets.
Mammals			
Fresno kangaroo rat *Dipodomys nitratoides exilis*	E	No designated critical habitat in the Action Area (50 *Federal Register* 4222–4226, January 30, 1985).	Alkali desert scrub habitats between 200 and 300 feet elevation.
San Joaquin (riparian) woodrat *Neotoma fuscipes riparia*	E	None designated.	Riparian forests.
Riparian brush rabbit *Sylvilagus bachmani riparius*	E	None designated.	Dense thickets of brush associated with riparian or chaparral habitats.
San Joaquin kit fox *Vulpes macrotis mutica*	E	None designated.	Saltbush scrub, grasslands, oak savannas, and freshwater scrub.

Source: USFWS 2009

Notes:
U.S. Fish and Wildlife Service Federal Listing Categories:
C = Candidate for listing
E = Federally listed as endangered
T = Federally listed as threatened

1.4.2 Species Eliminated from the Analysis

Certain species on the preliminary list were eliminated from further consideration either because suitable habitat for the species or the species itself is not present in the area that could be affected by implementing the Proposed Action. Table 1-4 lists the Federally listed species identified on NMFS and USFWS species lists that would not be affected by the Proposed Action and provides supporting rationale for eliminating each species from the analysis.

Table 1-4.
Federally Listed Fish, Plant, and Wildlife Species Not Affected by WY 2010 Interim Flows

Species	Federal Status	Critical Habitat	Habitat Association	Potential for Occurrence
Fish Species				
Central California Coast Steelhead *Oncorhynchus mykiss*	T	No designated critical habitat in the Action Area (70 Federal Register 52488—52536, September 2, 2005).	Drainages of San Francisco, San Pablo, and Suisun bays eastward to Chipps Island at confluence of the Sacramento and San Joaquin rivers.	Unlikely; the Action Area does not overlap the range of the species.
Plant Species				
Chinese Camp brodiaea *Brodiaea pallida*	T	None designated.	Seeps and springs in serpentinite or volcanic soils; 1,200 feet elevation.	Unlikely; this species is known from only two occurrences, both near Chinese Camp and outside the Action Area (north of Don Pedro Reservoir).
California jewelflower *Caulanthus californicus*	E	None designated.	Saline-alkaline soils in shadscale scrub, valley and foothill grassland, pinyon-juniper woodland, 0–3,000 feet elevation.	Unlikely; the only known occurrence in the vicinity has been extirpated and the only known extant occurrences are in Santa Barbara Canyon, the Carrizo Plain, and the Kreyenhagen Hills of the Mt. Diablo Range.
Soft bird's-beak *Cordylanthus mollis* ssp. *mollis*	E	No designated critical habitat in the Action Area (72 *Federal Register* 18518–18553, April 12, 2007).	Saltgrass-pickleweed marshes at or near the limits of tidal action; 0–10 feet elevation.	Unlikely; this species' current distribution is restricted to San Pablo and Suisun bays, and it has been extirpated from the Delta.
Contra Costa wallflower *Erysimum capitatum* ssp. *angustatum*	E	No designated critical habitat in the Action Area (43 *Federal Register* 39042–39044, August 31, 1978).	Inland sand dunes; 10–65 feet elevation.	Unlikely; this species is known from only three occurrences at the Antioch Dunes. The dunes are hydrologically isolated from the San Joaquin River and flood flows would not be altered in the dunes.

Table 1-4.
Federally Listed Fish, Plant, and Wildlife Species Not Affected by WY 2010 Interim Flows (contd.)

Species	Federal Status	Critical Habitat	Habitat Association	Potential for Occurrence
Plant Species (contd.)				
Contra Costa goldfields *Lasthenia conjugens*	E	No designated critical habitat in the Action Area (70 *Federal Register* 46923–46999, August 11, 2005).	Northern basalt flow, northern claypan, and northern volcanic ashflow vernal pools, swales, and moist flats; historic occurrences in saline-alkaline transition zone between vernal pool and tidal marsh habitat; known from 5 to 1,400 feet elevation, but most are between 5 and 200 feet elevation.	Unlikely; there are no known extant occurrences in the vicinity of the Action Area.
San Joaquin woollythreads *Monolopia congdonii*	E	None designated.	Alkali sinks and valley and foothill grassland with sandy soils; 200–2,650 feet elevation.	Unlikely; historic record of this species in the Tranquility quadrangle, but this record is several miles from the river and possibly extirpated (last seen in 1935).
Antioch Dunes evening-primrose *Oenothera deltoides* ssp. *howellii*	E	No designated critical habitat in the Action Area (43 *Federal Register* 39042–39044, August 31, 1978).	Inland sand dunes; 10–100 feet elevation.	Unlikely; known from only three native occurrences at the Antioch Dunes. The dunes are hydrologically isolated from the San Joaquin River and flood flows would not be altered in the dunes.
Hartweg's golden sunburst *Psuedobahia bahiafolia*	E	None designated.	Cismontane and valley and foothill grassland with shallow, well-drained sandy loam soils, with mima mound topography; 50–500 feet elevation.	Unlikely; this species occurs in upland habitats far above the river channel and no suitable habitat is present in the Action Area.
Red Hills (California) vervain *Verbena californica*	T	None designated.	Serpentine soils in mesic areas along intermittent or perennial streams, often in overflow channels; 850–1,150 feet elevation.	Unlikely; known only from the Red Hills area of Tuolumne County. No suitable habitat is present in the Action Area.

Table 1-4.
Federally Listed Fish, Plant, and Wildlife Species Not Affected by WY 2010 Interim Flows (contd.)

Species	Federal Status	Critical Habitat	Habitat Association	Potential for Occurrence
Wildlife Species				
Lange's metalmark butterfly *Apodemia mormo langei*	E	None designated.	Sand dunes where the larval food plant, naked-stem buckwheat (*Eriogonum nudum* ssp. *auriculatum*) is present.	Unlikely to occur in the Action Area. Historically restricted to sand dunes along the south bank of the Sacramento and San Joaquin rivers, and is currently found only at the Antioch Dunes in Contra Costa County.
Delta green ground beetle *Elaphrus viridis*	T	No designated critical habitat in the Action Area (45 *Federal Register* 52807–52810, August 8, 1980).	Vernal pool grasslands.	Unlikely to occur in the Action Area. Only known to occur in the greater Jepson Prairie area in south-central Solano County.
California red-legged frog *Rana aurora draytonii*	T	No designated (71 *Federal Register* 19244–19346, April 13, 2006) or proposed revised designated critical habitat in the Action Area (73 *Federal Register* 53492–53680, September 16, 2008).	Aquatic habitats, such as creeks, streams, and ponds.	Unlikely to occur in the San Joaquin, Merced, Stanislaus, and Tuolumne rivers; no longer occurs on the floor of the Central Valley and rare within the foothills.
California clapper rail *Rallus longirostris obsoletus*	E	None designated.	Salt and brackish marshes of the San Francisco Bay estuary.	Not expected to be affected by the Proposed Action. Interim Flow effects in the Delta are expected to be so minimal that changes in vegetation communities are not likely to occur.
Giant kangaroo rat *Dipodomys ingens*	E	None designated.	Annual grasslands and shrubland habitats with sparse vegetative cover	Unlikely to occur in the Action Area although historically known from the region; now known to occur only in the Kettleman Hills in Kings County and western Kern County

Table 1-4.
Federally Listed Fish, Plant, and Wildlife Species Not Affected by WY 2010 Interim Flows (contd.)

Species	Federal Status	Critical Habitat	Habitat Association	Potential for Occurrence
Wildlife Species (contd.)				
Salt marsh harvest mouse *Reithrodontomys raviventris*	E	None designated.	Saline emergent wetlands of San Francisco Bay and its tributaries.	Not expected to be affected by the Proposed Action. Effects in the Delta of Interim Flows are expected to be so minimal that changes in vegetation communities are not likely to occur.

Source: USFWS 2009
Notes:
U.S. Fish and Wildlife Service Federal Listing Categories:
E = Federally listed as endangered
T = Federally listed as threatened

1.5 Critical Habitat

Critical habitat is defined in Section 3(5)A of the ESA as the specific areas within the geographical area occupied by the species on which are found physical or biological features essential to the conservation of the species and that may require special management considerations or protection (15 USC 1632A). Specific areas outside of the geographical area occupied by the species may also be included in designations of critical habitat, upon a determination that such areas are essential for the conservation of the species.

NMFS has identified several “Primary Constituent Elements” (PCE) which are essential to the conservation of the species. These PCEs include criteria to protect freshwater spawning and rearing sites and migration corridors; estuarine areas; and nearshore and offshore marine areas. Under the jurisdiction of NMFS, the Proposed Action (WY 2010 Interim Flows) addressed in this BA may adversely modify designated critical habitat for Central Valley steelhead and proposed critical habitat for the Southern DPS of the North American green sturgeon.

The Proposed Action addressed in this BA may adversely modify critical habitat for the following species under USFWS’s jurisdiction: delta smelt, succulent owl’s-clover, Hoover’s spurge, Colusa grass, hairy Orcutt grass, Greene’s tuctoria, Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, and California tiger salamander.

1.6 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act require Federal agencies to consult with NMFS on any activity that they fund, permit, or carry out that may adversely affect EFH. The EFH regulations require Federal agencies obligated to consult on EFH to also provide NMFS with a written assessment of the effects of their actions on EFH (50 CFR 600.920). NMFS is required to provide EFH conservation and enhancement recommendations to the Federal agencies. The statute also requires Federal agencies that receive NMFS conservation recommendations on EFH to provide a detailed written response to NMFS within 30 days from receipt. The Federal agency's response must detail how the agency intends to avoid, mitigate, or offset the effect of the activity on EFH (Section 305(b)(4)(B)). This BA includes evaluation of EFH for Pacific salmon and Pacific coast groundfish.

2.0 Consultation to Date

Table 2-1 lists, in chronological order, the consultations held to date between Reclamation and USFWS and/or NMFS for the WY 2010 Interim Flows. Major discussion topics, including important guidance or key decisions, are summarized. Consultation generally has been regular and ongoing for more than 1 year, primarily as part of the Environmental Compliance Permitting and Work Group (ECPWG), which includes staff from all Implementing Agencies, including Reclamation, USFWS, and NMFS. In addition, members of the Fisheries Management Work Group (FMWG) also including staff from the Implementing Agencies were involved in stages of the consultation process. ESA compliance for the WY 2010 Interim Flows and the SJRRP as a whole has been discussed on a regular basis as summarized in Table 2-1. The ECPWG and FMWG members continue to meet regularly to discuss ESA issues.

Table 2-1.
Endangered Species Act Consultation Conducted for the SJRRP

Date	Meeting	USFWS Personnel Present	NMFS Personnel Present	Important Decisions/Guidance Given/General Discussion
March 25, 2008	ECPWG meeting	Mark Littlefield	None	Mark Littlefield will seek input from his staff regarding the specific areas in which surveys will need to be completed for specific species before releasing Interim Flows.
April 8, 2008	ECPWG meeting	Mark Littlefield	None	The group discussed the differences in surveys needed to permit Interim and Restoration Flows versus those needed to permit the entire program.
June 10, 2008	ECPWG meeting	Mark Littlefield	None	It was discussed that Interim Flows in WY 2010 might require minimal species/habitat surveys, including surveys for the California tiger salamander. The group is assuming that Interim Flows will not use Reach 4B1.
July 23, 2008	ECPWG meeting	Mark Littlefield	None	The current Interim Flows description includes flows from October 2009 through September 2010, going to Mendota Pool to be recovered by the Exchange Contractors. Interim Flows beyond 2010 will be covered through the PEIS/R.

Table 2-1.
Endangered Species Act Consultation Conducted for the SJRRP (contd.)

Date	Meeting	USFWS Personnel Present	NMFS Personnel Present	Important Decisions/Guidance Given/General Discussion
July 29, 2008	ESA/ CESA meeting	Mark Littlefield and Maryann Owens	None	Some changes have occurred to the 2009–2010 Interim Flows project as a result of discussions with SWRCB. Reclamation needs to apply for temporary change permit with SWRCB. Interim flows would be for the period between October 1, 2009, and September 30, 2010. Interim Flow releases are not expected to reach Mendota Pool. Reclamation's water rights do not include fish and wildlife habitat, so the purpose of use identified in the rights would need to be changed under Water Code Section 1705 to accommodate this use. It was discussed how more water in Reaches 1 and 2 related to the Interim Flows could affect listed species in Mendota Pool. Giant garter snake may be an issue, but the addition of more water may be beneficial to the species. Maryann Owens inquired about giant garter snake surveys completed approximately 5 years ago. Julie Vance (DFG) will follow up about the availability of these data. The historical occurrence of bank swallow in Mendota Pool is likely not an issue, because habitat has been altered and is no longer suitable for nesting. A question about what the maximum flows were for the pilot study. (They were estimated to be between 600 and 1,000 cubic feet per second.) The pilot study received concurrence from USFWS that there would not likely be an adverse effect on Federally listed species. In addition, no take of State-listed species would occur. Julie Vance (DFG) and Maryann Owens (USFWS) think that a similar conclusion may be appropriate for the Interim Flows project, but they need to discuss with John Beam (DFG) the potential water level effects in Mendota Pool before making a determination.
October 28, 2008	ECPWG meeting	Mark Littlefield and Stephanie Rickabaugh	None	The group discussed the potential to send Interim Flows in WY 2010 through the Eastside Bypass to the Delta. The compliance associated with this action is expected to require an EIS/R, which would be difficult to complete in the allotted time frame, particularly considering the additional endangered species thought to be present in the bypass (e.g., button celery). Combined with uncertainty on the authority to use the bypass, the group recommends restricting Interim Flows to Mendota Pool.

Table 2-1.
Endangered Species Act Consultation Conducted for the SJRRP (contd.)

Date	Meeting	USFWS Personnel Present	NMFS Personnel Present	Important Decisions/Guidance Given/General Discussion
November 4, 2008	ECPWG meeting	Mark Littlefield	None	The team discussed the state of WY 2010 Interim Flows project description. The group discussed the location of potential habitat for blunt-nosed leopard lizard in Reach 2B because it relates to potential levee setbacks in this reach.
November 18, 2008	ECPWG meeting	Stephanie Rickabaugh	None	The group agreed that if Interim Flows would be delivered to the Delta, the action would no longer be exempt from CEQA and could require an EIS/R, as well as a BO and would therefore take enough time to affect the schedule. Therefore, Interim Flows should not be delivered past the Merced River confluence. The group agreed to include two flow delivery points (wildlife refuges in Reach 5, Mendota Pool) in the EA to ensure coverage for environmental review and permitting.
December 2, 2008	ECPWG meeting	Stephanie Rickabaugh	None	Interim Flows were discussed generally.
December 16, 2008	ECPWG meeting	Stephanie Rickabaugh	None	The WY 2010 Interim Flows project description is nearing completion and will be ready for review soon. The current description includes sending flows to the wildlife refuges upstream from the Merced River confluence.
January 6, 2009	ECPWG meeting	Stephanie Rickabaugh	None	Interim Flows were discussed generally.
January 20, 2009	ECPWG meeting	Stephanie Rickabaugh		Stephanie Rickabaugh requested spatial inundation information on the WY 2010 Interim Flows, which MWH will provide from MEI. This information will allow a better understanding of the potential to affect special-status species.
February 3, 2009	ECPWG meeting	Stephanie Rickabaugh	None	Because of potential issues with giant garter snake habitat in the backwater area of Mendota Pool, more discussion is needed in the EA on the potential changes in stage operations at Mendota Pool. Reclamation will look into operations at Mendota Pool to determine whether there is potential active storage available that could result in backwater stage changes. Because of the potential that blunt-nosed leopard lizard habitat exists in the Eastside Bypass, Stephanie Rickabaugh requested better information on the potential inundation at Interim Flow levels. Stephanie stated that a finding of not likely to adversely affect blunt-nosed leopard lizard would require informal consultation with USFWS.

Table 2-1.
Endangered Species Act Consultation Conducted for the SJRRP (contd.)

Date	Meeting	USFWS Personnel Present	NMFS Personnel Present	Important Decisions/Guidance Given/General Discussion
February 17, 2009	ECPWG meeting	Stephanie Rickabaugh	None	Reclamation described the two alternatives to be included in the EA/IS. The two alternatives will include the No-Action Alternative and one action alternative. The action alternative will describe sending flows as far as China Island in Reach 5; however, if legal constraints (such as land access) or regulatory constraints (such as discovery of the presence of a species fully protected by the State), flows will be delivered to an intermediate point (either the East Bear Creek Unit of the San Luis National Wildlife Refuge Complex or Mendota Pool) to avoid such constraints. Stephanie Rickabaugh and John Battistoni (DFG) will develop the survey protocol for blunt-nosed leopard lizard.
February 19, 2009	Reclamation meeting	None	Erin Strange and Leslie Mirise	Reclamation gave a briefing on the SJRRP to bring NMFS up to speed on current status. The WY 2010 Interim Flows proposal was discussed along with the overall SJRRP compliance strategies.
March 3, 2009	ECPWG meeting	Stephanie Rickabaugh	None	Interim Flows were discussed generally.
March 4, 2009	PMT Meeting	Dan Castleberry, John Engbring, Jeff McLain	Rhonda Reed	Expand the description for water year 2009-10 to include flows below Merced. Everyone agreed to pursue this change in strategy. NMFS comfortable with its ability to meet time lines and suggested Reclamation work with them on the draft BA as early as possible
March 19, 2009	ESA/CESA meeting	Stephanie Rickabaugh and Maryann Owens	Leslie Mirise	Blunt-nosed leopard lizard survey protocol from USFWS and DFG will be sent to Reclamation next week and will be used to determine the survey effort. It was noted that ESRP mapped elderberry shrubs throughout Reaches 1–5 and surveyed most of the shrubs for exit holes in 2004–2005; however, USFWS typically considers results valid for only 1 year.
March 24, 2009	ECPWG meeting	Stephanie Rickabaugh	Leslie Mirise	Stephanie Rickabaugh and John Battistoni (DFG) have completed the blunt-nosed leopard lizard survey protocols and are awaiting USFWS signature.
April 7, 2009	ECPWG meeting	Stephanie Rickabaugh	Leslie Mirise	Blunt-nosed leopard lizard surveys were discussed.

Table 2-1.
Endangered Species Act Consultation Conducted for the SJRRP (contd.)

Date	Meeting	USFWS Personnel Present	NMFS Personnel Present	Important Decisions/Guidance Given/General Discussion
April 16, 2009	ESA/CESA meeting	Stephanie Rickabaugh	None	Brad Hubbard (Reclamation) stated that there are issues obtaining land access in the bypass channel to survey for blunt-nosed leopard lizards; therefore, DFG and USFWS will meet on April 24, 2009, to discuss the possibility of assuming presence. The Interim flow BA outline will be sent to NMFS for its review and comment. It was agreed that there will be only one Interim Flows BA that will discuss terrestrial and aquatic species. Stephanie Rickabaugh would like more information on several species in the EA (e.g., riparian brush rabbit, California tiger salamander, valley elderberry longhorn beetle, San Joaquin kit fox). Stephanie Rickabaugh recommends that Reclamation make an environmental commitment in the Interim Flows BA to complete vegetation base maps. It was decided that the pictures taken during the invasive species surveys would not suffice for the recommended vegetation base map.
April 17, 2009	Reclamation meeting	John Engbring and Stephanie Rickabaugh	None	Special-status species strategy details, including the strategy for the blunt-nosed leopard lizard ESA/CESA approach for the WY 2010 Interim Flows proposal, were discussed.
April 21, 2009	ECPWG meeting	Stephanie Rickabaugh	Leslie Mirise	Leslie Mirise stated that NMFS needs to know if the Hills Ferry Barrier can withstand the expected Interim Flows, if the barrier will be replaced in the early spring to block steelhead, and if this will be considered a significant effect. One BA that addresses aquatic and terrestrial species for the Interim Flows will be developed by May 15, 2009, and will not address CESA. USFWS recommends that Reclamation make an environmental commitment to perform vegetation base mapping for the Interim Flows. NMFS and USFWS reviewed the draft BA outline.
April 22, 2009	Interim Flows meeting	Stephanie Rickabaugh	Leslie Mirise	The SJRRP office staff will provide a technical paper regarding expected operational requirements for the Hills Ferry Barrier that was drafted in support of legislation. The EA/IS description of actions related to the Hills Ferry Barrier will be revised based on this paper. Generally, the project description will include no change to the operation of the Hills Ferry Barrier.

Table 2-1.
Endangered Species Act Consultation Conducted for the SJRRP (contd.)

Date	Meeting	USFWS Personnel Present	NMFS Personnel Present	Important Decisions/Guidance Given/General Discussion
May 1, 1009	ESA/ CESA meeting	Stephanie Rickabaugh and Jeff McLain	Leslie Mirise	NMFS confirmed that Action Area for WY 2010 BA should extend to the south Delta. Jeff McLain provided revised Hills Ferry Barrier text to be inserted into the EA/IS and BA

Key:
BA = biological assessment
BO = biological opinion
CEQA = California Environmental Quality Act
EA/IS = environmental assessment/initial study
ECPWG = Environmental Compliance and Permitting Working Group
EIS/R = environmental impact statement/report
ESA/CESA = Endangered Species Act/California Endangered Species Act
ESRP = Endangered Species Recovery Program, California State University Stanislaus
MEI = Mussetter Engineering, Inc.
MWH = Montgomery Watson Harza
NMFS = National Marine Fisheries Service
PEIS/R = program environmental impact statement/report
SJRRP = San Joaquin River Restoration Program
SWRCB = State Water Resources Control Board
USFWS = U.S. Fish and Wildlife Service
WY = water year

3.0 Description of the Proposed Action

3.1 Overview of the San Joaquin River Restoration Program

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and the CVP Friant Division Long-Term Contractors. After more than 18 years of litigation of this lawsuit, known as *NRDC, et al. v. Kirk Rodgers, et al.*, a Settlement was reached. On September 13, 2006, the Settling Parties – NRDC, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce—agreed on the terms and conditions of the Settlement, which was subsequently approved by the U.S. Eastern District Court of California on October 23, 2006.

The Settlement establishes two primary goals:

- **Restoration Goal –** To restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

- **Water Management Goal –** To reduce or avoid adverse water supply impacts on all of the Friant Division Long-Term Contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The SJRRP will implement the Settlement. The implementing agencies responsible for managing the SJRRP are the U.S. Department of the Interior, through Reclamation and USFWS, U.S. Department of Commerce through NMFS, and the California Resources Agency through the California Department of Water Resources (DWR), DFG, and the California Environmental Protection Agency. The Settlement also stipulates the appointment of a Restoration Administrator (RA), in consultation with a technical advisory committee, to make recommendations to the U.S. Secretary of the Interior to help in meeting the Restoration Goal.

The Settlement stipulates the releases of both Interim Flows and Restoration Flows. The release of Interim Flows is to begin October 1, 2009, and continue until full Restoration Flows begin. The purpose of the Interim Flows is to collect relevant data on flows, temperatures, fish needs, seepage losses, recirculation, recapture, and reuse. Full Restoration Flows are described in Exhibit B of the Settlement.

The Act was passed by Congress on March 19, 2009, and signed into law by the President on March 30, 2009. The Act authorizes the Secretary of the Interior to direct and implement the following terms and conditions of the Settlement:

(1) Design and construct channel and structural improvements as described in Paragraph 11.

(2) Modify the operation of Friant Dam to provide Restoration Flows and Interim Flows.

(3) Acquire water, water rights, or options to acquire water as described in Paragraph 13.

(4) Implement the terms and conditions stipulated in Paragraph 16 related to recirculation, recapture, reuse, exchange, or transfer of water released for Restoration Flows and Interim Flows.

(5) Develop and implement the Recovered Water Account as specified in Paragraph 16(b), including the pricing and payment crediting provisions described in Paragraph 16(b)(3).

The actions proposed by Reclamation to implement Interim Flows in WY 2010 are needed to achieve compliance with the Act.

3.2 Description of the Restoration Area

The Restoration Area is defined geographically as the San Joaquin River from Friant Dam to the Merced River confluence. The San Joaquin River and flood bypasses within the Restoration Area are described as a series of physically and operationally distinct reaches, as shown in Figure 3-1 and defined in Table 3-1. Table 3-1 also identifies which river reaches and bypasses are included in the Restoration Area for evaluation of the Proposed Action. The geographic areas are described briefly below.

Millerton Lake and San Joaquin River from Kerckhoff Dam to Friant Dam

The San Joaquin River originates in the Sierra Nevada at an elevation of 12,000 feet above mean sea level (North American Vertical Datum 1988). Millerton Lake, formed by Friant Dam, is the largest reservoir on the San Joaquin River. Habitat surrounding Millerton Lake is fairly sparse, and the lake is surrounded by low hills. Inflow consists primarily of flows from the upper San Joaquin River and is influenced by the operation of several upstream hydropower generation projects, including those at Kerckhoff Dam. Millerton Lake typically fills during late spring and early summer, when San Joaquin River flows are high because of snowmelt in the upper watershed. Friant Dam diverts much of the water from the San Joaquin River to contractors within the CVP Friant Division’s water service area. Annual water allocations and release schedules are developed with the intent of drawing down reservoir storage to minimum levels by the end of September. The operation of Friant Dam changes storage levels in Millerton Lake, which in turn can influence resources affected by storage conditions and lake levels.

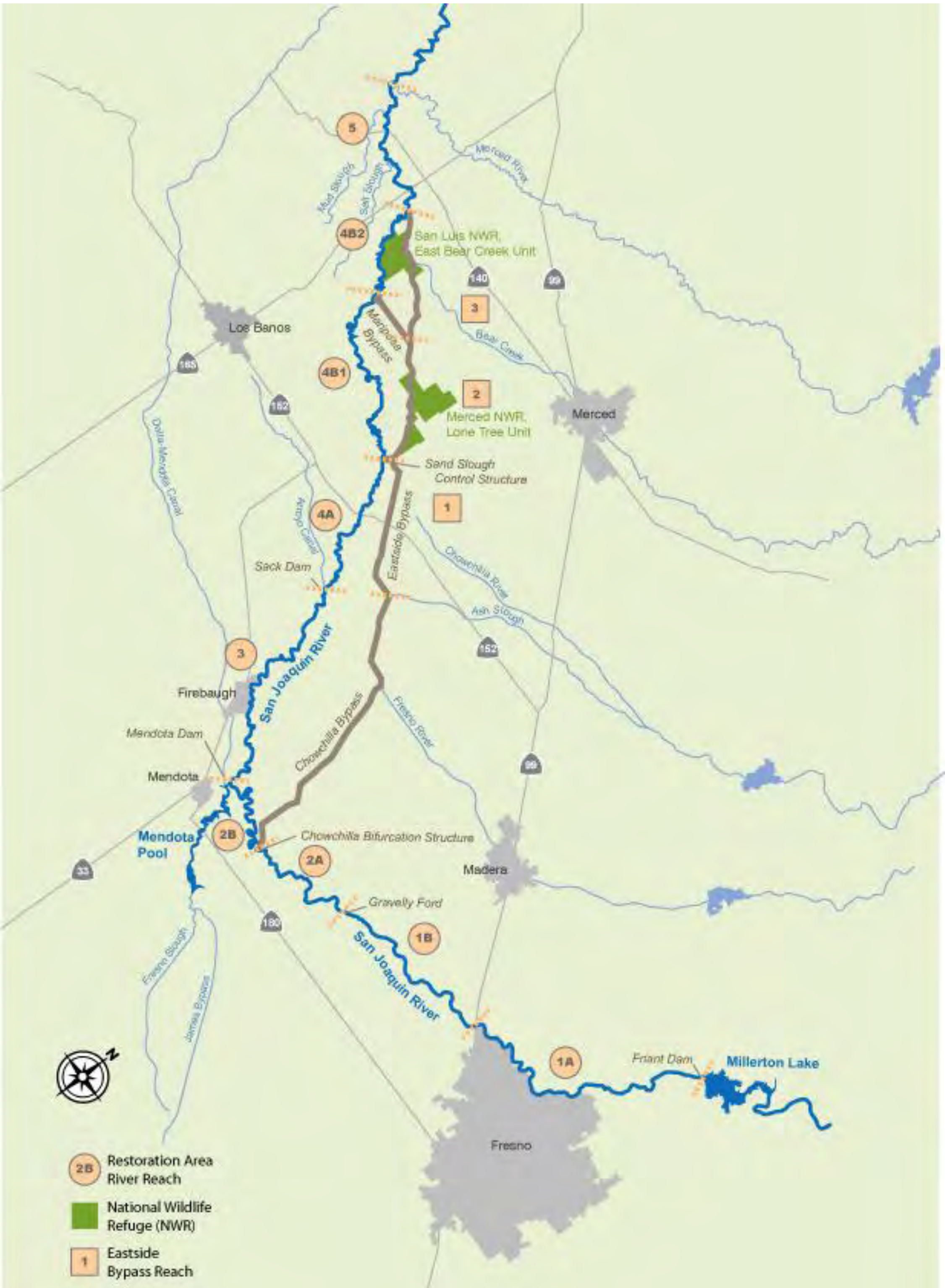


Figure 3-1.
San Joaquin River Reaches and the Flood Bypass System in the Restoration Area

Table 3-1.
San Joaquin River Reaches and Flood Bypasses in the Restoration Area Located within the Restoration Area for Water Year 2010 Interim Flows

<table>
<tr><th colspan="4">San Joaquin River Reaches and Flood Bypasses in the Restoration Area</th><th rowspan="2">Restoration Area Reaches Included in Water Year 2010 Interim Flows Restoration Area</th></tr>
<tr><th>River or Bypass</th><th>Reach</th><th>Head of Reach or Bypass</th><th>Downstream End of Reach or Bypass</th></tr>
<tr><td rowspan="9">San Joaquin River</td><td>1A</td><td>Friant Dam</td><td>State Route 99</td><td>✓</td></tr>
<tr><td>1B</td><td>State Route 99</td><td>Gravelly Ford</td><td>✓</td></tr>
<tr><td>2A</td><td>Gravelly Ford</td><td>Chowchilla Bifurcation Structure</td><td>✓</td></tr>
<tr><td>2B</td><td>Chowchilla Bifurcation Structure</td><td>Mendota Dam</td><td>✓</td></tr>
<tr><td>3</td><td>Mendota Dam</td><td>Sack Dam</td><td>✓</td></tr>
<tr><td>4A</td><td>Sack Dam</td><td>Sand Slough Control Structure</td><td>✓</td></tr>
<tr><td>4B1</td><td>Sand Slough Control Structure</td><td>Confluence with Mariposa Bypass</td><td></td></tr>
<tr><td>4B2</td><td>Confluence with Mariposa Bypass</td><td>Confluence with Bear Creek and Eastside Bypass</td><td>✓</td></tr>
<tr><td>5</td><td>Confluence with Bear Creek and Eastside Bypass</td><td>Confluence with Merced River</td><td>✓</td></tr>
<tr><td colspan="2">Chowchilla Bypass</td><td>Chowchilla Bifurcation Structure</td><td>Confluence with Ash Slough and Eastside Bypass</td><td></td></tr>
<tr><td colspan="2">Eastside Bypass</td><td>Confluence with Ash Slough and Chowchilla Bypass</td><td>Confluence with Bear Creek and San Joaquin River</td><td>✓</td></tr>
<tr><td colspan="2">Sand Slough Bypass</td><td>Sand Slough Control Structure</td><td>Eastside Bypass</td><td>✓</td></tr>
<tr><td colspan="2">Mariposa Bypass</td><td>Mariposa Bypass Bifurcation Structure</td><td>Confluence with San Joaquin River</td><td>✓</td></tr>
</table>

San Joaquin River from Friant Dam to the Merced River

SJRRP restoration activities focus on this approximately 150-mile reach of the San Joaquin River, termed the Restoration Area. The river and flood bypasses within the Restoration Area are a series of physically and operationally distinct reaches, as shown in Figure 3-1 and described below.

Reach 1. Reach 1 begins at Friant Dam and continues approximately 37 miles downstream to Gravelly Ford. This reach conveys continuous flows to Gravelly Ford. The reach is divided into two subreaches, 1A and 1B. Reach 1A extends from Friant Dam to State Route 99. Reach 1B continues from State Route 99 to Gravelly Ford. Reach 1 is the principal area identified for future salmon spawning, but this reach has been extensively mined for instream gravel and sediment supply is limited.

Reach 2. Reach 2 begins at Gravelly Ford and extends approximately 24 miles downstream to the Mendota Pool, continuing the boundary between Fresno and Madera counties. This reach marks the end of the incised channel and is a meandering channel of low gradient. Reach 2 is subdivided into two subreaches at the Chowchilla Bifurcation Structure. Both Reach 2A and Reach 2B are dry in most months. Reach 2A is subject to extensive seepage losses. Sand has accumulated in this subreach because of such factors as backwater effects of the Chowchilla Bifurcation Structure and the lower gradient of Reach 2A relative to Reach 1. Reach 2B is a sandy channel with limited conveyance capacity.

Reach 3. Reach 3 of the San Joaquin River conveys perennial flows of Delta water released from the Mendota Pool to Sack Dam, where flows are diverted to the Arroyo Canal. This reach continues the boundary between Fresno and Madera counties. The sandy channel meanders approximately 23 miles through a primarily agricultural area; diversion structures are common in this reach.

Reach 4. Reach 4 is approximately 46 miles long and is subdivided into three distinct subreaches. Reach 4A begins at Sack Dam and extends to the Sand Slough Control Structure. This subreach is dry in most months because flows are diverted to the Arroyo Canal at Sack Dam. All flows that reach the Sand Slough Control Structure are diverted to the flood bypass system via the Sand Slough Bypass, which has left Reach 4B1 perennially dry (with the exception of agricultural return flows) for more than 40 years. Reach 4B2 begins at the confluence of the Mariposa Bypass, where flood flows in the bypass system rejoin the mainstem San Joaquin River. Reach 4B2 extends to the confluence of the Eastside Bypass.

Reach 5. Reach 5 of the San Joaquin River extends approximately 18 miles from the confluence of the Eastside Bypass downstream to the Merced River confluence. This reach receives flows from Mud and Salt sloughs, channels that run through both agricultural and wildlife management areas.

Fresno Slough/James Bypass. Fresno Slough, also referred to as the James Bypass, conveys flood flows in some years from the Kings River system in the Tulare Basin to the Mendota Pool. These flows are regulated by Pine Flat Dam.

Chowchilla Bypass and Tributaries. The Chowchilla Bifurcation Structure at the head of Reach 2B regulates the flow split between the San Joaquin River and the Chowchilla Bypass. Operation of the structure is based on flows in the San Joaquin River, flows from the Kings River system via Fresno Slough, water demands in the Mendota Pool, and seasonality. Tributaries to the Chowchilla Bypass include the Fresno River and Berenda Slough. The Chowchilla Bypass extends to the confluence of Ash Slough, which marks the beginning of the Eastside Bypass.

Eastside Bypass, Mariposa Bypass, and Tributaries. The Eastside Bypass extends from the confluence of Ash Slough and the Chowchilla Bypass to the confluence with the San Joaquin River at the head of Reach 5. It is subdivided into three reaches. Reach 1 of the Eastside Bypass extends from Ash Slough to the Sand Slough Bypass confluence and receives flows from the Chowchilla River. Reach 2 of the Eastside Bypass extends from the Sand Slough Bypass confluence to the head of the Mariposa Bypass. Reach 3 of the Eastside Bypass extends from the head of the Mariposa Bypass to the head of San Joaquin River Reach 5 and receives flows from Deadman, Owens, and Bear creeks. The Mariposa Bypass extends from the Mariposa Bypass Bifurcation Structure to the head of San Joaquin River Reach 4B2. A drop structure located near the downstream end of the Mariposa Bypass dissipates energy from flows before they enter the mainstem San Joaquin River.

San Joaquin River from the Merced River to the Sacramento–San Joaquin Delta

The San Joaquin River downstream from the Merced River confluence to the Delta receives inflow from several large rivers, including the Merced, Tuolumne, and Stanislaus rivers. Several smaller rivers also join the San Joaquin River below the Stanislaus River confluence.

Sacramento–San Joaquin Delta

The Delta is a network of islands and channels at the confluence of the Sacramento and San Joaquin rivers. The Delta comprises approximately 750,000 acres, receives runoff from a watershed that includes more than 40 percent of California’s land area, and accounts for approximately 42 percent of the state’s annual runoff (Water Education Foundation 1992). Tributaries that directly discharge into the Delta include the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras rivers. The Delta supplies water for most of California’s agricultural production and many urban and industrial communities across the state.

In the Delta, the Banks and the Jones pumping plants move water from the Delta to a system of canals and reservoirs for agricultural, municipal and industrial, and environmental uses in the San Joaquin Valley and the San Francisco Bay Area, along the central coast, and in portions of southern California. Surface-water resources in the Delta are influenced by the interaction of tributary inflows, tides, Delta hydrodynamics, regulatory requirements, and water management actions (e.g., reservoir releases, in-Delta diversions, and transfers).

The Delta also provides habitat for numerous plant, animal, and fish species, including several threatened or endangered species. The Delta serves as a migration path for all Central Valley anadromous species that return to their natal rivers to spawn; adult Chinook salmon move through the Delta during most of the year.

3.2.1 Merced River, Tuolumne River, and Stanislaus River

The Merced, Tuolumne, and Stanislaus rivers flow west from the Sierra Nevada to the San Joaquin River. Each of these rivers supports fisheries, including fall-run Chinook salmon. The confluence of the Merced River with the San Joaquin River is located at the end of San Joaquin River Reach 5. During high-flow events, a portion of Merced River flows is conveyed to the San Joaquin River through Merced Slough. The Tuolumne River flows approximately 150 miles to the San Joaquin River near Modesto and hosts fisheries for anadromous and other fish species. The Stanislaus River flows into the San Joaquin River just upstream from Vernalis.

3.3 Proposed Action

3.3.1 Summary

The Proposed Action is the implementation of the WY 2010 Interim Flows, including the release and potential downstream recapture of Interim Flows, the actions necessary to convey the flows in the San Joaquin River system to the Delta, and the monitoring action to be conducted during the WY 2010 Interim Flow releases. Interim Flows would be released to the San Joaquin River from Friant Dam October 1 to November 20, 2009, and February 1 to September 30, 2010, in accordance with the flow schedule presented in Exhibit B of the Settlement. Estimated maximum nonflood flows for each reach of the Restoration Area under the Proposed Action are shown in Table 3-2. Table 3-3 shows the change in estimated maximum nonflood flows under the Proposed Action. Estimated maximum nonflood flows in Tables 3-3 and 3-4 represent nonflood conditions in a Wet water year; flows would vary depending on the water year-type. The water year-type for WY 2010 cannot be determined until spring 2010.

WY 2010 Interim Flows released from Friant Dam would flow through the Restoration Area, combine with flows from major tributaries, and enter the Delta. However, these Interim Flows would be reduced or diverted as needed to avoid causing substantial adverse conditions in downstream reaches, as identified by the measures described in Section 3.5, “Environmental Commitments.”

The Proposed Action involves recapturing Interim Flows at locations along the San Joaquin River, in the Delta, or both to the maximum extent possible during WY 2010, and transferring this water back to the Friant Division Long-Term Contractors. The farthest downstream that Interim Flows could be recaptured during WY 2010 would be at the Jones and Banks pumping plants. The Proposed Action includes several diversion locations where Interim Flows could be recaptured:

- Existing CVP and SWP facilities in the Delta.
- The Mendota Pool at the downstream end of San Joaquin River Reach 2B.
- The Arroyo Canal at the downstream end of San Joaquin River Reach 3.
- The Lone Tree Unit of the Merced NWR (Lone Tree Unit) in Reach 2 of the Eastside Bypass.
- The East Bear Creek Unit of the San Luis NWR (East Bear Creek Unit) in Reach 3 of the Eastside Bypass.

WY 2010 Interim Flows recaptured along the San Joaquin River may provide deliveries in lieu of Delta-Mendota Canal (DMC) supplies. In this case, Delta exports would not change under the Proposed Action. Up to a like amount of exported water would be available for recirculation to the Friant Division using south-of-Delta facilities. No additional agreements would be required to recapture flows in the Restoration Area. Mutual agreements between Reclamation, DWR, the Friant Division Long-Term

Contractors, and other south-of-Delta CVP/SWP contractors could be required before recaptured water could be recirculated to the Friant Division.

Implementing the Proposed Action would result in a negligible increase in Delta inflow. It also would result in small changes to allowable Delta exports under existing operating criteria, consistent with prevailing and relevant laws, regulations, BOs, and court orders in place at the time the water is recaptured. Any additional Delta exports would be eligible for recirculation to the Friant Division. Subsequent exchange agreements between Reclamation, DWR, the Friant Division Long-Term Contractors, and other south-of-Delta CVP/SWP contractors could be required before this water could be recirculated. Recirculation would be subject to available capacity within the Jones and Banks pumping plants, the California Aqueduct, the DMC, San Luis Reservoir and related pumping facilities, and other storage and conveyance facilities of CVP/SWP contractors.

Recaptured water available to the Friant Division Long-Term Contractors would range from zero to the total amount of WY 2010 Interim Flows reaching the Delta. Reclamation would identify actual reductions in deliveries to the Friant Division Long-Term Contractors associated with releasing the WY 2010 Interim Flows.

Several other implementation considerations could further constrain the release of WY 2010 Interim Flows: water supply demand; operations of Mendota and Sack dams; agreements with landowners and other Federal, State, and local agencies; potential effects on listed species; and the potential for seepage. Each of these topics is discussed in further detail in Section 3.4, “Implementation Considerations.”

Table 3-2.
Estimated Maximum Nonflood Flows by Reach Under the Proposed Action

Timing of Interim Flow Releases		Estimated Maximum Flows (Interim Flows and Water Right Flows) at Locations in the Restoration Area[1] (cubic feet per second)									
Beginning Date	Ending Date	Head of Reach 1[2]	Head of Reach 2A[3]	Head of Reach 2B[4]	Head of Reach 3[5]	Head of Reach 4A[6]	In Reach 4B1	In Reach 4B2	In Eastside Bypass[6]	Head of Reach 5	Merced River Confluence[7]
10/1/2009	10/31/2009	350	195	115	715	115	0	115	115	115	415
11/1/2009	11/6/2009	700	575	475	1,075	475	0	475	475	475	775
11/7/2009	11/10/2009	700	575	475	1,075	475	0	475	475	475	775
11/11/2009	11/20/2009	350	235	155	755	155	0	155	155	155	555
11/21/2009[8]	1/31/2010[9]	120	5	0	600	0	0	0	0	0	400
2/1/2010	2/28/2010	350	255	175	775	175	0	175	175	175	675
3/1/2010	3/15/2010	500	375	285	885	285	0	285	285	285	785
3/16/2010	3/31/2010	1,500	1,375	1,225	1,300	1,225	0	1,225	1,225	1,225	1,700
4/1/2010	4/15/2010	1,620	1,475	1,300	1,300	1,300	0	1,300	1,300	1,300	1,700
4/16/2010	4/30/2010	1,620	1,475	1,300	1,300	1,300	0	1,300	1,300	1,300	1,700
5/1/2010	6/30/2010	1,660	1,475	1,300	1,300	1,300	0	1,300	1,300	1,300	1,700
7/1/2010	8/31/2010	350	125	45	645	45	0	45	45	45	320
9/1/2010	9/30/2010	350	145	65	665	65	0	65	65	65	340
Estimated Maximum Total Volume (thousand acre-feet)		605	493	411	702	411	0	411	411	411	681

Notes:
1 Regulated nonflood releases from Friant Dam and deliveries by the Delta-Mendota Canal, exclusive of agricultural return flows and natural drainage.
2 Assumes up to 230 cubic feet per second diverted by instream water right holders (e.g., holding contracts), consistent with Exhibit B of the Settlement.
3 Assumes up to 200 cubic feet per second lost through infiltration, consistent with Exhibit B of the Settlement.
4 Assumes up to approximately 2,600 cubic feet per second in maximum diversion capacity in the Mendota Pool for water right holders. Estimated maximum Interim Flows at the head of Reach 2B in water year 2010 account for seepage losses experienced in Reach 2A, consistent with Exhibit B of the Settlement.
5 Assumes up to 600 cubic feet per second released from the Mendota Pool to Reach 3 for diversions into the Arroyo Canal at Sack Dam.
6 Assumes up to 25 percent of flow lost through infiltration downstream from Sack Dam, and up to 80 cubic feet per second diverted at wildlife refuges.
7 Assumes accretions from Mud and Salt sloughs in Reach 5, consistent with Exhibit B of the Settlement.
8 No Interim Flows during this portion of water year 2010.
9 Assumes a Wet water year-type. Flows may be lower under other water year-types.

Table 3-3.
Change in Estimated Maximum Nonflood Flows Under the Proposed Action from Baseline Conditions

Timing of Interim Flow Releases		Change in Estimated Maximum Flows at Locations in the Restoration Area[1] (cubic feet per second)									
Beginning Date	Ending Date	Head of Reach 1[2]	Head of Reach 2A[3]	Head of Reach 2B[4]	Head of Reach 3[5]	Head of Reach 4A[6]	In Reach 4B1	In Reach 4B2	In Eastside Bypass[6]	Head of Reach 5	Merced River Confluence[7]
10/1/2009	10/31/2009	190	190	115	115	115	0	115	115	115	115
11/1/2009	11/6/2009	570	570	475	475	475	0	475	475	475	475
11/7/2009	11/10/2009	570	570	475	475	475	0	475	475	475	475
11/11/2009	11/20/2009	230	230	155	155	155	0	155	155	155	155
11/21/2009[8]	1/31/2010[8]	0	0	0	0	0	0	0	0	0	0
2/1/2010	2/28/2010	250	250	175	175	175	0	175	175	175	175
3/1/2010	3/15/2010	370	370	285	285	285	0	285	285	285	285
3/16/2010	3/31/2010	1,370	1,370	1,225	700	1,225	0	1,225	1,225	1,225	1,225
4/1/2010	4/15/2010	1,470	1,470	1,300	700	1,300	0	1,300	1,300	1,300	1,300
4/16/2010	4/30/2010	1,470	1,470	1,300	700	1,300	0	1,300	1,300	1,300	1,300
5/1/2010	6/30/2010	1,470	1,470	1,300	700	1,300	0	1,300	1,300	1,300	1,300
7/1/2010	8/31/2010	120	120	45	45	45	0	45	45	45	45
9/1/2010	9/30/2010	140	140	65	65	65	0	65	65	65	65
Estimated Maximum Total Volume (thousand acre-feet)		489	489	411	273	411	0	411	411	411	411

Notes:
1 Regulated nonflood releases from Friant Dam and deliveries by the Delta-Mendota Canal, exclusive of agricultural return flows and natural drainage.
2 Assumes up to 230 cubic feet per second diverted by instream water right holders (e.g., holding contracts), consistent with Exhibit B of the Settlement.
3 Assumes up to 200 cubic feet per second lost through infiltration, consistent with Exhibit B of the Settlement.
4 Assumes up to 2,621 cubic feet per second in maximum diversion capacity in the Mendota Pool for water right holders.
5 Assumes up to 600 cubic feet per second released from the Mendota Pool to Reach 3 for diversions into the Arroyo Canal at Sack Dam.
6 Assumes up to 25 percent of flow lost through infiltration downstream from Sack Dam, and up to 80 cubic feet per second diverted at wildlife refuges.
7 Assumes accretions from Mud and Salt sloughs in Reach 5, consistent with Exhibit B of the Settlement.
8 No Interim Flows during this portion of water year 2010.

3.3.2 Settlement Flow Schedules

The annual quantity of water to be released from Friant Dam as WY 2010 Interim Flows under the Proposed Action is defined by the hydrologic year–type classifications provided in Exhibit B, consistent with the Restoration Flow Guidelines (SJRRP 2008). The allocated quantity would be applied to the hydrographs in Exhibit B and reduced, as appropriate, within the limits of channel capacity (see Table 3-4), anticipated infiltration losses, and diversion capacities. Additional reductions in flow could be made, in consideration of water supply demands, presence of listed species, and potential seepage effects, as described in Section 3.4 and in the Seepage Monitoring and Management Plan, as described in Section 3.5.1. The resulting hydrograph would be subject to the application of flexible flow provisions described in Exhibit B, as requested by the RA. Settlement provisions related to Buffer Flows and purchased-water provisions are not applicable to Interim Flows. Guidance provided in the Settlement would further define the schedule and magnitude of flow releases and additional modifications to flows.

Table 3-4.
Estimated Maximum Water Year 2010 Interim Flows by Reach

Reach	Estimated Deliveries[1] (cfs)	Infiltration Losses[1] (cfs)	Estimated Existing Channel Capacity[2] (cfs)	Estimated Maximum Flow in Reach[3,4] (cfs)
1	230	0	8,000	1,660
2A	0	200	8,000	1,475
2B	0	0	1,300	1,300
3	0	0	1,300	1,300
4A	0	0	4,500	1,300
4B1[5]	0	0	0	0
4B2	0	0	4,500	1,300
5	0	0	26,000	1,775[6]
Mariposa Bypass	0	0	8,500	1,300
Eastside Bypass Reach 1	0	0	17,000	1,300
Eastside Bypass Reach 2	0	0	16,500	1,300
Eastside Bypass Reach 3	0	0	13,500	1,300

Sources: McBain and Trush 2002; RMC 2003, 2007

Notes:

[1] Loss estimates incorporated into flow targets, as defined in Exhibit B of the Settlement. Includes infiltration losses in Reach 2, and water right diversions in Reach 1.

[2] Estimated existing nondamaging channel capacity is based on best available information and may be revised as new information becomes available as part of the SJRRP.

[3] Nonflood conditions.

[4] Does not include potential discontinuous local flow such as agricultural and natural drainage.

[5] The Proposed Action does not include any activity in Reach 4B1.

[6] Includes existing inflow from Mud and Salt sloughs of up to 500 cfs, as defined in Exhibit B.

Key:
cfs = cubic feet per second

Restoration Year-Type Classification

To facilitate future implementation of the Settlement, the SJRRP has developed a year-type classification system based on annual October-through-September unimpaired flow below Friant Dam from WY 1922 through WY 2004 (SJRRP 2008), as shown in Table 3-5.

Table 3-5.
Restoration Year-Types as Defined in Exhibit B of the Settlement

Restoration Year-Type[1]	Range of Unimpaired Inflow to Millerton Lake (acre-feet per year)	Percentage of Years from 1922 Through 2005
Wet	Greater than 2,500,000	20 percent
Normal-Wet	Greater than 1,450,000 to 2,500,000	30 percent
Normal-Dry	Greater than 930,000 to 1,450,000	30 percent
Dry	Greater than 670,000 to 930,000	15 percent
Critical-High	400,000 up to 670,000	5 percent
Critical-Low	Less than 400,000	

Note:
[1] A restoration year begins October 1 and ends on September 30 of the following calendar year.

The restoration year-type for WY 2010 Interim Flow releases will be determined and finalized in June 2009 using information considered in making water supply allocations, including the DWR *Bulletin 120* forecast (being finalized in May 2009).

Schedule and Magnitude of Restoration Flow Releases

The RA may recommend additional changes in specific release schedules, such as ramping rates, to smooth the transition through the hydrograph, as long as such changes would not alter the total amount of water required to be released pursuant to the applicable hydrograph. The Wet-year flow schedule, shown in Figure 3-2, identifies the estimated maximum effects associated with WY 2010 Interim Flow releases, but would be reduced, as appropriate, by the limits of channel capacity. This flow schedule is used to determine potential impacts in this BA.

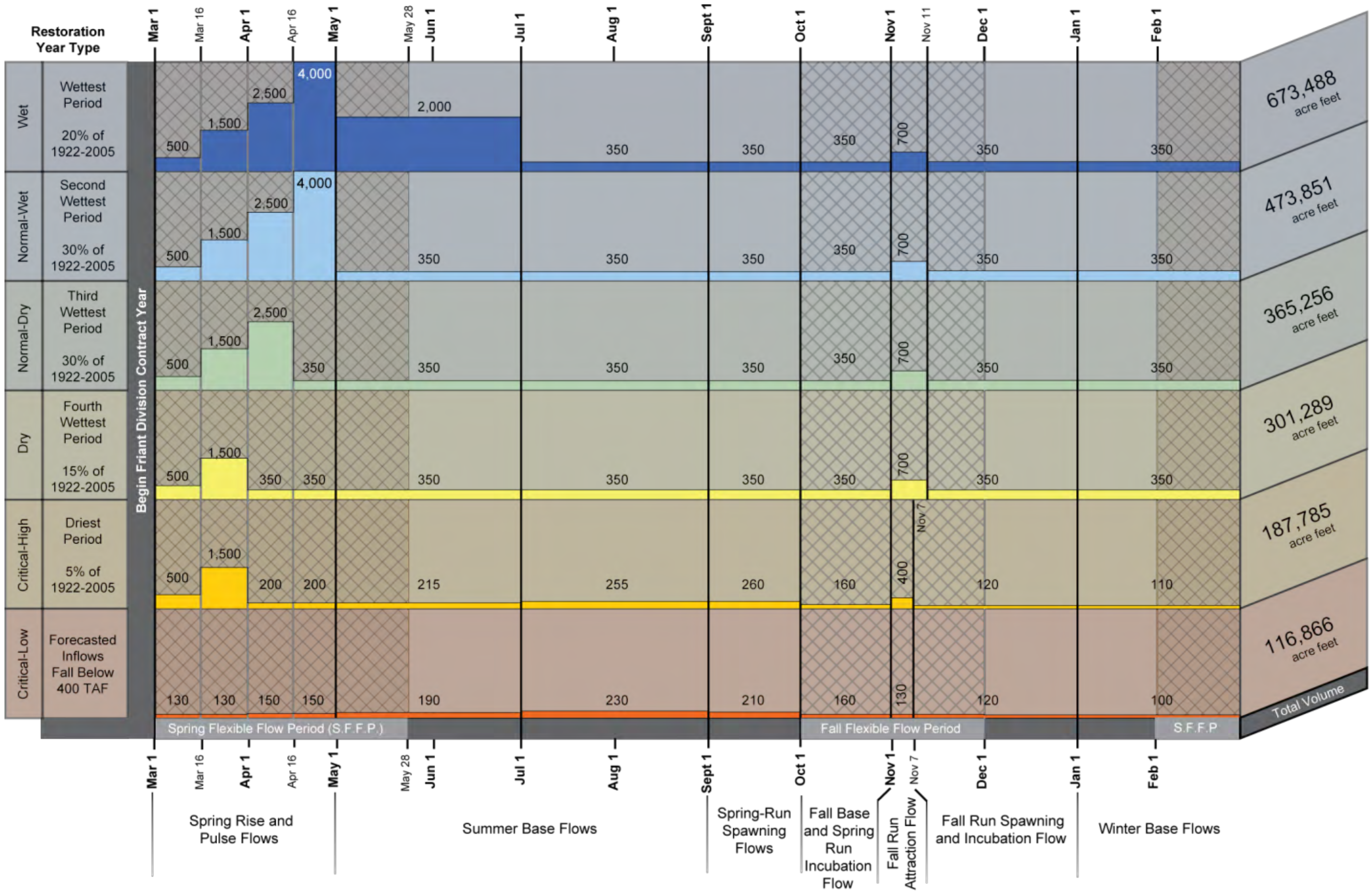


Figure 3-2.
Restoration Flow Schedules by Restoration Year-Type, as Specified in Exhibit B of the Settlement

Flow Modifications

The Settlement defines several additional modifications to flow schedules to benefit fisheries within the Restoration Area. These modifications include flexible flow periods, Buffer Flows, and the acquisition and release of additional water. Because Chinook salmon will not be reintroduced to the river during WY 2010, and because the purpose of WY 2010 Interim Flows is to collect relevant data, WY 2010 Interim Flows would not include the application of Buffer Flows or the release of additional water.

WY 2010 Interim Flows could include application of flexible flow periods to provide additional data collection opportunities. The Settlement identifies flexible flow periods during spring and fall periods that allow flows to be shifted up to 4 weeks earlier or later than shown in the Exhibit B flow schedules. During flexible flow periods, the water released may be less than the volume identified in the flow schedule because of constraints (such as channel capacity). The volume of Restoration Flows above the estimated maximum WY 2010 Interim Flows would not be applied earlier or later within the flexible flow period to increase the total allocation made for the appropriate year type, as illustrated in Figure 3-3.

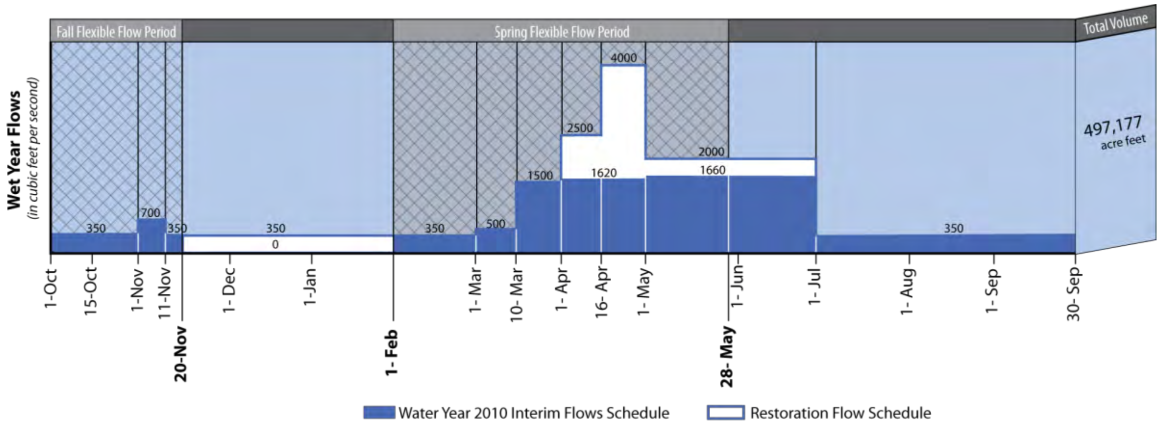


Figure 3-3.
Estimated Maximum Average Water Year 2010 Interim Flows from Friant Dam Assuming a Wet Year

3.3.3 Flow Considerations by Reach

The maximum downstream extent of WY 2010 Interim Flows that could be recaptured would be at the Jones and Banks pumping plants in the Delta. Maximum flows released from Friant Dam would be based on downstream conveyance capacity and forecasted water year type. The river and flood bypasses within the Restoration Area are described as a series of physically and operationally distinct reaches, with channel capacity constraints, gains, and infiltration losses, as defined in the following sections. Considerations within each reach and below the Merced River confluence are described below.

Under existing nonflood conditions, most reaches of the San Joaquin River and the associated bypass system within the Restoration Area convey local agricultural return flows and runoff. Under flood conditions, seepage through levees has been observed. The release of WY 2010 Interim Flows would gradually increase to target flow rates while seepage is monitored. As described in the Act, WY 2010 Interim Flows would be reduced, as needed. Monitoring and management actions are part of the Proposed Action operations, and are described in more detail in the Seepage Monitoring and Management Plan presented in Appendix D, Attachment 1.

The release of WY 2010 Interim Flows would be managed to avoid interfering with operations of the San Joaquin River Flood Control Project. This includes operations of the Chowchilla Bypass Bifurcation Structure, Sand Slough Control Structure, Eastside Bypass Bifurcation Structure, and Mariposa Bypass Bifurcation Structure, as well as San Joaquin River Flood Control Project levee maintenance. Specifically, under the Proposed Action, no change in flood operations at the Chowchilla Bypass Bifurcation Structure would occur. Releases of flood flows to the San Joaquin River would remain constrained by the capacity of the portion of Reach 2B below the Chowchilla Bypass Bifurcation Structure.

Reach 1

Channel capacity in Reach 1 is approximately 8,000 cfs, which exceeds the estimated maximum potential flow releases from Friant Dam under the WY 2010 Interim Flows. Therefore, channel capacity would not limit WY 2010 Interim Flows in Reach 1. The Exhibit B flow schedules include assumed holding contract releases to Reach 1, as shown in Table 3-6. Estimated maximum flows under the Proposed Action, as shown in Table 3-2, include releases to meet these diversions. Because this channel carries continuous flow under existing conditions, Reach 1 is not expected to lose water through infiltration of flows released over and above Reach 1 holding contract releases.

Table 3-6.
Riparian Releases Identified in Reach 1 in Exhibit B of the Settlement

Timing of WY 2010 Interim Flows		Reach 1 Riparian Releases (cfs)
Beginning Date	Ending Date	
10/1/2009	10/31/2009	160
11/1/2009	11/6/2009	130
11/7/2009	11/10/2009	130
11/11/2009	11/20/2009	120
11/21/2009	1/31/2010	120
2/1/2010	2/28/2010	100
3/1/2010	3/15/2010	130
3/16/2010	3/31/2010	130
4/1/2010	4/15/2010	150
4/16/2010	4/30/2010	150
5/1/2010	6/30/2010	190
7/1/2010	8/31/2010	230
9/1/2010	9/30/2010	210

Key:
cfs = cubic feet per second
WY = water year

Reach 2

Estimated maximum WY 2010 Interim Flows would be constrained by the existing channel capacity of Reach 2B. DWR has estimated the channel capacity in Reach 2B to be 1,500 cfs. Local landowners have stated that the conveyance capacity of Reach 2B is approximately 1,300 cfs (RMC 2007). Therefore, estimated maximum WY 2010 Interim Flows would not exceed 1,300 cfs in Reach 2B. To accommodate this presumed capacity limitation, WY 2010 Interim Flow releases at Friant Dam would be less than the quantity included in the Exhibit B flow schedules from April 1 to June 30 of 2010, if the year-type is determined to be normal-dry, normal-wet, or wet. Table 3-7 shows the capacity restrictions on estimated maximum flows, reflecting nonflood conditions in a wet year.

The Exhibit B flow schedules include assumptions about infiltration losses in Reach 2A (Table 3-7). Estimated maximum nonflood flows under the Proposed Action (Table 3-2) include these losses.

Table 3-7.
Infiltration Losses Identified for Reach 2A and in Exhibit B

Timing of Interim Flow Releases		Infiltration Losses in Reach 2A by Year-Type (cfs)					
Beginning Date	**Ending Date**	**Critical-Low**	**Critical-High**	**Dry**	**Normal-Dry**	**Normal-Wet**	**Wet**
10/1/2009	10/31/2009	80	80	80	80	80	80
11/1/2009	11/6/2009	100	100	100	100	100	100
11/7/2009	11/10/2009	80	80	100	100	100	100
11/11/2009	11/20/2009	80	80	80	80	80	80
11/21/2009	1/31/2010	*No WY 2010 Interim Flows During this Period*					
2/1/2010	2/28/2010	80	80	80	80	80	80
3/1/2010	3/15/2010	90	90	90	90	90	90
3/16/2010	3/31/2010	150	150	150	150	150	150
4/1/2010	4/15/2010	80	80	80	175	175	175
4/16/2010	4/30/2010	80	80	80	80	200	200
5/1/2010	6/30/2010	80	80	80	80	80	165
7/1/2010	8/31/2010	80	80	80	80	80	80
9/1/2010	9/30/2010	80	80	80	80	80	80

Key:
cfs = cubic feet per second
WY = water year

WY 2010 Interim Flows would flow through Reach 2 and the Mendota Pool, unless downstream considerations (e.g., channel capacity, presence of special-status species) require that less (or no) flow enters Reach 3. Under the Proposed Action, WY 2010 Interim Flows could be diverted from the Mendota Pool to the extent that these flows would meet demands, replacing CVP water supplies that otherwise would be delivered via the DMC. The DMC carries water from the Delta to the Mendota Pool, where it is diverted through several existing pumps and canals with a combined capacity that exceeds upstream channel capacity, and therefore would not constrain WY 2010 Interim Flows. WY 2010 Interim Flows would be diverted by CVP contractors at the Mendota Pool in lieu of using supplies typically delivered via the DMC. Therefore, CVP water supplies in south-of-Delta facilities would be available for delivery to the Friant Division, subject to existing agreements with other south-of-Delta CVP contractors for the use of water storage and conveyance facilities.

Central California Irrigation District (CCID) operates and maintains Mendota Dam in Reach 2. CCID is responsible for maintaining the dam under a very narrow operating range and provides no operational storage for water supply operations (RMC 2003). The San Luis Delta Mendota Water Authority (SLDMWA) operates and maintains the Mendota Pool on behalf of Reclamation. The Mendota Pool is held at a fairly constant elevation between 14.2 and 14.5 feet above mean sea level to maintain deliveries to water users in the upper end of the Mendota Pool/Fresno Slough areas (RMC 2003). To maintain this constant elevation, releases from Mendota Dam need to be made via the gates and with boards at the dam in place. The gates have a release capacity of approximately 1,500 cfs. Under the Proposed Action, operations at the Mendota Pool would maintain water-surface elevations within the range of existing operations.

Reach 3

Reach 3 currently conveys flows from the Mendota Dam to the Arroyo Canal at Sack Dam for diversion. Diversions to the Arroyo Canal range from zero to 800 cfs, and typically do not exceed 600 cfs. Flows in Reach 3 vary based on the time of year, water demands, and available water supplies. Release constraints at the Mendota Pool are implemented to avoid potential adverse effects associated with the diversion capabilities identified above. The RMC has reported that Reach 3 conveys up to 800 cfs of water for irrigation diversions at Sack Dam, and that higher flows (less than 4,500 cfs) can cause seepage and levee stability problems in this reach (2007). In 2006, the U.S. Geological Survey recorded a mean maximum daily discharge of 4,590 cfs; DWR reported that seepage occurred on lands in and adjacent to the floodway at this time. DWR has estimated the capacity of interior levees in this reach to be 1,300 cfs with 3 feet of freeboard. WY 2010 Interim Flow releases from Mendota Dam would be reduced in proportion to releases from Mendota Dam by the San Joaquin River Exchange Contractors for diversion at the Arroyo Canal, such that the combined WY 2010 Interim Flows and irrigation supply flows would not exceed 1,300 cfs. Because Reach 3 currently conveys flow, it is assumed that infiltration losses related to WY 2010 Interim Flows in Reach 3 would be negligible.

WY 2010 Interim Flows would flow through Reach 3 and Sack Dam, unless downstream considerations (such as channel capacity or potentially adverse effects) require that less flow enters downstream reaches, as described above for Reach 2. Under the Proposed Action, WY 2010 Interim Flows could be diverted at the Arroyo Canal to the extent that these flows would meet demands (up to 800 cfs), replacing CVP water supplies that would otherwise be delivered via the Mendota Pool and DMC. This diversion could be combined with diversions at the Mendota Pool, as described above, and/or with reductions in flow release at Friant Dam to reduce inflow to Reach 4A.

Reach 4A

The estimated maximum flow in Reach 4A under the Proposed Action (nonflood conditions) would be 1,300 cfs because of upstream constraints described above for Reach 2B. No factors were identified in Reach 4A that would reduce or otherwise constrain WY 2010 Interim Flows.

Exhibit B assumes that Reach 4A experiences seasonal losses; however, these losses are not specified. Because Reach 4A conveys no flow in most years (i.e., is a dry channel), some initial infiltration losses are anticipated in this reach under WY 2010 Interim Flows. Flows would be monitored to obtain relevant information regarding infiltration losses.

WY 2010 Interim Flows at the downstream end of Reach 4A would be conveyed through Sand Slough to the Eastside Bypass. These flows would not be conveyed into Reach 4B1 because the capacity of Reach 4B1 is currently unknown and may be 0 cfs in some locations.

Eastside and Mariposa Bypasses

The estimated maximum WY 2010 Interim Flows conveyed to the Eastside and Mariposa bypasses would be 1,300 cfs because of upstream capacity constraints in Reach 2B, as described above. WY 2010 Interim Flows would enter Eastside Bypass Reach 2 via Sand Slough. Flows would either be routed through the Mariposa Bypass back to the San Joaquin River at the head of Reach 4B2, or through Eastside Bypass Reach 3 back to the San Joaquin River at the head of Reach 5.

Conveyance of WY 2010 Interim Flows through the Eastside and Mariposa bypasses would be limited, as necessary, by biological requirements determined through currently ongoing field surveys for listed species. In addition, agreements would be required with Eastside Bypass landowners to allow conveyance of WY 2010 Interim Flows. WY 2010 Interim Flows would be conveyed through the bypasses to Reaches 4B and 5, unless downstream considerations (such as channel capacity or potential take of listed species that could not be avoided) require that less (or no) flow enters the downstream reaches. Flow considerations in Eastside Bypass Reaches 2 and 3, and in the Mariposa Bypass, are discussed below.

Eastside Bypass Reach 2. If downstream considerations (such as channel capacity or potentially adverse effects) require that less (or no) flow enters reaches downstream from Eastside Bypass Reach 2, WY 2010 Interim Flows could be diverted in Eastside Bypass Reach 2 to the Lone Tree Unit (up to 20 cfs).

Under the Proposed Action, WY 2010 Interim Flows could be diverted at the Lone Tree Unit to the extent that these flows would meet demands, replacing other water supplies including Merced Irrigation District deliveries. This diversion could be combined with diversions at the Mendota Pool and/or Arroyo Canal, as described for Reaches 2 and 3, and/or with reductions in flow release at Friant Dam to reduce or eliminate inflow to Eastside Bypass Reach 3.

The Lone Tree Unit has historically diverted water from Eastside Bypass Reach 2 using a 25-horsepower permanent lift station last operated in 1997 (Forrest, pers. comm., 2009). The Lone Tree Unit currently diverts water from the Eastside Bypass using a 350-horsepower portable pump. The pumps are ordinarily operated in conjunction with weirs to back up water in the bypass to provide temporary habitat for waterfowl. To maintain suitable conditions within the ponded water, flow-through is maintained past the weirs.

Eastside Bypass Reach 3. If considerations in Mariposa Bypass and Reach 4B2 or in downstream reaches (such as channel capacity or potential take of listed species that could not be avoided) require that less (or no) flow enters those reaches, WY 2010 Interim Flows could be diverted to the East Bear Creek Unit in Eastside Bypass Reach 3.

Under the Proposed Action, WY 2010 Interim Flows could be diverted at the East Bear Creek Unit to the extent that these flows would meet demands, replacing CVP water supplies that would otherwise be delivered via the Mendota Pool and DMC. This diversion could be combined with diversions at the Mendota Pool, Arroyo Canal, and/or the Lone Tree Unit, as described for Reaches 2 and 3 and Eastside Bypass Reach 2, and/or with reductions in flow releases at Friant Dam to reduce or eliminate inflow to Eastside Bypass Reach 3.

The East Bear Creek Unit has a pump lift station in the Eastside Bypass with a diversion capacity of 60 cfs. This pump stations features a 48-inch-diameter intake structure and four 125-horsepower electric motors driving 15 cfs pumps. Under these circumstances, deliveries of WY 2010 Interim Flows to the East Bear Creek Unit would be further constrained by actual demand for water supplies at the East Bear Creek Unit.

The diversion of WY 2010 Interim Flows at the East Bear Creek Unit could be exchanged for CVP water supplies that otherwise would be delivered to the East Bear Creek Unit. These CVP water supplies would then be available for recirculation to the Friant Division. Reclamation would assist Friant Division long-term contractors with arranging agreements for the transfer or exchange of flows recaptured at these locations.

Mariposa Bypass. The estimated maximum flow in the Mariposa Bypass under the Proposed Action (nonflood conditions) would be 1,300 cfs because of upstream capacity constraints described above for Reach 2B. Conveyance of WY 2010 Interim Flows through the Mariposa Bypass would be limited, as described above, by biological requirements determined through field surveys for listed species and ensuring that flows are restricted to the low-flow channel. If downstream considerations require that less (or no) flow enters those reaches, WY 2010 Interim Flows would be diverted in upstream reaches, as described above.

Reach 4B

WY 2010 Interim Flows would not enter Reach 4B1. WY 2010 Interim Flows could be routed through Reach 2 of the Eastside Bypass and the Mariposa Bypass and conveyed to Reach 4B2, as shown in Figure 3-1. No factors were identified in Reach 4B2 that would reduce or otherwise constrain WY 2010 Interim Flows. Because of upstream capacity constraints in Reach 2B, as described above, the estimated maximum WY 2010 Interim Flow conveyed to Reach 4B2 would be 1,300 cfs.

Exhibit B states that Reach 4B is likely a gaining reach, but additional flows gained are not quantified in the Exhibit B flow schedules. The additional flows occur under baseline conditions and under the Proposed Action, but are not reflected in the estimated maximum nonflood flows shown in Tables 3-2 through 3-4.

Reach 5

The estimated maximum flow in Reach 5 under the Proposed Action (nonflood conditions) would be 1,300 cfs because of upstream capacity constraints described above for Reach 2B. No factors were identified in Reach 5 that would reduce or otherwise constrain WY 2010 Interim Flows.

Accretions in Reach 5 of up to 500 cfs from Mud and Salt sloughs are assumed in Exhibit B, are incorporated into the flow schedules shown in Table 3-4, and are reflected in the estimated maximum nonflood flows shown in Tables 3-3 through 3-5. Exhibit B assumes that Reach 5 gains additional flows of up to 50 cfs from other sources, but these are not incorporated into the Exhibit B flow schedules. These flows occur under baseline conditions and under the Proposed Action, but are not reflected in the estimated maximum nonflood flows shown in Tables 3-3 through 3-5.

Population numbers of Central Valley steelhead present on the San Joaquin tributaries (Stanislaus, Tuolumne, and Merced rivers) are unknown, owing to limited data, but the numbers likely range in the tens to low hundreds. Steelhead in the Restoration Area during Interim Flows are highly unlikely, and the Proposed Action will use existing facilities to prevent the unwanted upstream migration of Central Valley steelhead during fall Interim Flows (October 1 to November 20, 2009). Monitoring for the potential presence of Central Valley steelhead during spring Interim Flows (starting on February 1, 2010) would occur, and is further described below.

San Joaquin River Downstream from the Merced River Confluence

WY 2010 Interim Flows that reach the confluence of the Merced River could increase San Joaquin River flows by up to 1,300 cfs. The Merced, Tuolumne, and Stanislaus rivers are the three main tributaries to the lower San Joaquin River. Releases from major reservoirs on the three main tributaries are made in response to multiple operational objectives: flood management, downstream diversions, instream fisheries flows, instream water quality flows, and releases to meet water quality and flow objectives at Vernalis as part of requirements under the Vernalis Adaptive Management Program (VAMP). VAMP is an experimental program to release flows primarily from tributary reservoirs based on flow conditions on the San Joaquin River at Vernalis. VAMP flows include a 31-day pulse in April and May of up to 110 thousand acre-feet depending on estimated unimpaired flow conditions. Tributary releases to meet VAMP water quality objectives at Vernalis would be affected by the release of Interim Flows in WY 2010.

Sacramento–San Joaquin Delta

WY 2010 Interim Flows that reach the Delta, which would not exceed 1,300 cfs, could be diverted at existing CVP and SWP export facilities operated under existing regulatory requirements and institutional agreements. Because Reclamation does not hold a water right to Delta water for Friant Division deliveries, water recaptured in this manner would be available to existing south-of-Delta CVP and SWP water users. Available capacity within CVP/SWP storage and conveyance facilities could be used to facilitate exchanges and conveyance of water to the Friant Division by using recaptured Delta water supplies. Reclamation would assist the Friant Division Long-Term Contractors in arranging agreements for the transfer or exchange of flows recaptured at these locations. In addition, even if Interim Flows were not exported from the Delta, they would contribute to compliance with regulatory requirements in the Delta; as an indirect result, water released from upstream reservoirs to meet the regulatory requirements could be reduced by a commensurate amount. Recirculation would be subject to available capacity within the Jones and Banks pumping plants, the California Aqueduct, the DMC, San Luis Reservoir and related pumping facilities, and other storage and conveyance facilities of CVP/SWP contractors.

Evaluations of surface water resources and interrelated resources (e.g., water quality, fisheries, groundwater, socioeconomics) for this Draft EA/IS are based on a CalSim representation prepared in 2005 that reflects coordinated CVP/SWP long-term operations BOs in place at that time. Those BOs address the combined operational and regulatory setting under which the CVP and SWP facilities are operated. USFWS issued a new long-term operations BO in 2008, and NMFS is expected to issue a new long-term operations BO on listed Chinook salmon, steelhead, and green sturgeon in June 2009. Because the 2009 NMFS BO is still pending, and representations of 2008 USFWS BO Reasonable and Prudent Alternative (RPA) within numerical modeling tools are under development, the 2005 BO representation within CalSim is an appropriate tool for comparison purposes at this time. Further, the Proposed Action would continue to be in compliance with current or future long-term operations BOs.

3.4 Additional Implementation Considerations

Additional implementation considerations, such as potential environmental, regulatory, or legal issues, could further limit the release of WY 2010 Interim Flows, as described below.

Water Supply Demand

The maximum quantity of WY 2010 Interim Flows that could be diverted from the Restoration Area is limited by the combined diversion capacity at all identified diversion points. Actual diversions would be made according to demand for water supplies at these diversion points.

Implementation Agreements

Implementing the WY 2010 Interim Flows would require several agreements with local agencies. WY 2010 Interim Flows would be constrained by agreements in place at the time of release, including agreements with the San Joaquin River Exchange Contractors and USFWS regarding the timing and quantity of diversions. Additional agreements may include the following:

- **Central California Irrigation District** – As described above, CCID operates and maintains Mendota Dam. As part of normal operations, CCID dewaters the Mendota Pool approximately once every other year between November 25 and January 15 (RMC 2003) to conduct inspections required by the California Division of Safety of Dams. The Mendota Pool is scheduled to be dewatered in late 2009. If dewatering is scheduled during the WY 2010 Interim Flow periods identified in Table 3-1, no WY 2010 Interim Flow releases would be made to the Mendota Pool at that time. Agreements with CCID may be required before Interim Flows could be routed through Mendota Dam.

- **San Luis Canal Company** – San Luis Canal Company operates Sack Dam at the end of San Joaquin River Reach 3. Sack Dam is a 5-foot-high concrete and wood diversion structure that delivers water to the Arroyo Canal on the river's west side. Under typical base-flow conditions, all water that reaches Sack Dam is diverted to the Arroyo Canal. Flows greater than those required for diversion, including flood flows, spill over Sack Dam into the San Joaquin River. Agreements with San Luis Canal Company may be required before WY 2010 Interim Flows could be routed over Sack Dam.

- **Lower San Joaquin Levee District** – Agreements with the Lower San Joaquin Levee District may be required to operate, inspect, and maintain flood control facilities including levees, channels, flap gates, and bifurcation structures. These activities may include patrolling of levees to assess conditions, maintain channels, close flap gates prior to release of WY 2010 Interim Flows, and operate the Chowchilla, Eastside, and Mariposa bypass bifurcation structures.

- **U.S. Army Corps of Engineers** – Regulatory approval from USACE may be required to release Interim Flows from Friant Dam.

- **Central Valley Flood Protection Board** – Regulatory approval from the Central Valley Flood Protection Board may be required to release WY 2010 Interim Flows into the Eastside Bypass.

- **San Luis Delta Mendota Water Authority** – SLDMWA operates and maintains the Mendota Pool. Agreements with SLDMWA may be required before WY 2010 Interim Flows could be routed through the Mendota Pool.

Reclamation has initiated discussions with Central California ID, San Luis Canal Company, Lower San Joaquin Levee District, and staff at the Central Valley Flood Protection Board regarding implementing the Proposed Action. These discussions are ongoing. All agreements must be in place before introducing WY 2010 Interim Flows into the respective area of the river. Additionally, the amount of WY 2010 Interim Flows may be limited if any of the above agreements cannot be reached and/or if the terms of any of the above agreements include activities that limit flows.

3.5 Environmental Commitments

3.5.1 Minimization Commitments for Effects of Flows

Seepage Monitoring and Response Actions

The Act requires that a seepage monitoring program be prepared before releasing Interim Flows. The Seepage Monitoring and Management Plan (Appendix D) describes the monitoring and management guidelines included in the Proposed Action as related to groundwater or levee seepage. Some portions of the Restoration Area have historically experienced groundwater seepage to adjacent lands associated with elevated flows. Groundwater seepage has the potential to cause waterlogging of crops and salt mobilization in the crop root zone. Similarly, some portions of the Restoration Area have experienced levee instability resulting from through-levee and under-levee seepage during periods of elevated flows.

As part of the SJRRP, monitoring wells are being permitted and installed at several transects along the San Joaquin River in the Restoration Area to identify groundwater level responses to river flows. Reclamation and DWR would monitor groundwater levels in installed wells. Observed groundwater levels would be used by the Secretary in determining when to reduce flow releases from Friant Dam as required by the Act. Following installation of each monitoring well, groundwater elevations thresholds would be developed in consideration of nearby land uses, known groundwater and subsurface conditions, and other information available or provided by landowners.

In general, groundwater depth thresholds would be classified in three ranges (Figure 3-4):

- *An acceptable zone* at which groundwater levels are not expected to affect agricultural production.
- *A buffer zone* indicating an increased likelihood that seepage could affect agricultural production without flow modification.
- *An threat zone* representing groundwater levels that affect agricultural production.

The Proposed Action includes flow reductions in response to groundwater levels observed in the buffer or threat zones.

Other potential thresholds that would be used to identify the need for action include the following:

- Surface water stage corresponding to known or observed levee stability problems and lateral seepage
- Visual observation of boils or piping
- Landowner communication of observed seepage problems

If groundwater levels at a monitoring well exceed an identified threshold, WY 2010 Interim Flows would be reduced or diverted.

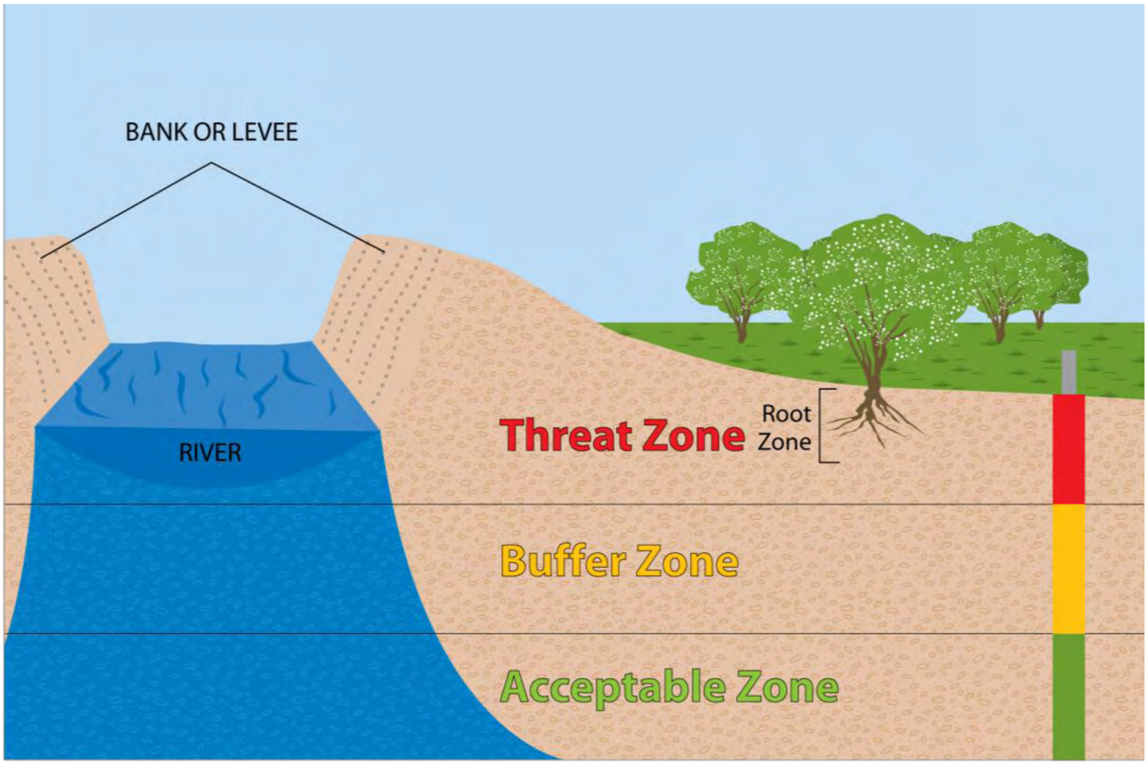


Figure 3-4.
Potential Groundwater Seepage Thresholds Zones

Flow Monitoring

The Act requires that a flow monitoring program be prepared before releasing Interim Flows. The Flow Monitoring and Management Plan describes management objectives for WY 2010 Interim Flows, approaches for measuring WY 2010 Interim Flows, conditions indicating that management objectives have been attained, and potential actions that could be taken to address nonattainment of the WY 2010 Interim Flow objectives. The Flow Monitoring and Management Plan will include measurement of streamflows at six locations within the Restoration Area.

3.5.2 Conservation Measures for Listed Species

The presence of certain special-status species in the Action Area may determine specific quantities and routing of instream flows, as discussed below.

Delta Fish Species

Ongoing consultations on Delta fish species with USFWS, NMFS, and DFG are occurring to comply with the Federal ESA; consultation is required to implement the Proposed Action. The maximum downstream extent of WY 2010 Interim Flows that could be recaptured would be at the Jones and Banks pumping plants. Recapture of WY 2010 Interim Flows at the Jones and Banks pumping plants would be subject to existing or future regulatory requirements and would be done in compliance with existing or future long-term operations BOs.

Hills Ferry Barrier

The current Hills Ferry Barrier is a type of resistance weir commonly used to exclude and/or trap anadromous fish in rivers. This barrier consists of panels aligned perpendicular to the flow of the river with evenly spaced pipes that allow water, small fish, and particles to pass but prevent larger anadromous fish such as Chinook salmon from passing upstream. Operated by DFG since 1992, the Hills Ferry Barrier is typically installed in mid-September and operated until it is removed in early December. DFG currently operates the Hills Ferry Barrier near the town of Newman, approximately 300 feet upstream from the confluence with the Merced River (in Reach 5).

The barrier's main purpose is to redirect upstream-migrating adult fall-run Chinook salmon into suitable spawning habitat in the Merced River and prevent migration into the mainstem San Joaquin River upstream, where conditions are currently unsuitable for Chinook salmon. Central Valley steelhead migrate during fall and spring in a manner similar to migration by fall-run Chinook salmon, and they have a similar body type; therefore, maintenance of the Hills Ferry Barrier would continue for the purpose of redirecting Chinook salmon during the fall WY 2010 Interim Flow period. The barrier is expected to be equally effective in redirecting any Central Valley steelhead.

NMFS permits the take of Federally listed threatened species for various State and nongovernmental agencies through the ESA Section 10a(1)A and 4(d) rules in the unlikely event that that anadromous fish, including Central Valley steelhead, stray into San Joaquin River reaches above the Merced River. DFG applies annually for an ESA Section 4(d) research permit and accompanying take limit for Central Valley steelhead from NMFS for operation of the barrier. In 2008, DFG was allowed to take up to five Central Valley steelhead. DFG was issued a permit for 2009 (expires on December 31, 2009) with a take limit of 10 Central Valley steelhead. If Central Valley steelhead are encountered at or above the Hills Ferry Barrier during fall Interim Flows, the Central Valley steelhead would be released downstream in suitable reaches as required by the permit.

Historic streamflow conditions upstream from the Merced River confluence during the spring averaged from 119 cfs to 13,050 cfs, with peak flows reaching 59,000 cfs in 1997. WY 2010 Interim Flows may add an average of up to 220 cfs at this location beginning on February 1, 2010. This small increase is not anticipated to trigger any change to Central Valley steelhead migration patterns in the San Joaquin Basin. As well, WY 2010 Interim Flows will not be released if natural flows approach channel capacity. However, the Proposed Action will develop a monitoring plan to check for Central Valley steelhead in the Restoration Area during spring Interim Flows. In the event a steelhead is encountered in the Restoration Area, NMFS will be notified immediately. In addition, stranded steelhead will be recovered and returned downstream in an appropriate location designated by DFG and/or NMFS. Salvaged fish will likely have genetic samples (i.e., fin clips) taken.

Preflow Release Surveys for Blunt-Nosed Leopard Lizard

In the absence of avoidance measures, blunt-nosed leopard lizard (BNLL) in the Eastside and Mariposa bypasses could be adversely affected. The presence of BNLL would be determined based on the results of preflow release surveys of the Eastside and Mariposa bypasses, conducted by qualified biologists in accordance with USFWS survey methodologies for BNLL developed specifically for the SJRRP. Surveys would be conducted for 12 days during the optimal survey period for adults (April 15 to July 15), with a maximum of 4 days per week and 8 days within any 30-day time period. At least one survey would be conducted for 4 consecutive days. In addition, surveys would be conducted for 5 days during the optimal survey period for hatchlings (August 1 to September 15).

If an area that may have suitable habitat has not been surveyed for BNLL, Interim Flows that could potentially inundate habitat would not be released in that area. No measures to avoid take of BNLL have been identified beyond withholding Interim Flows from reaches with identified habitat. Based on information gathered during BNLL surveys, avoidance measures would be identified as needed. If these avoidance measures are agreed on during consultation with USFWS, and implemented to fully avoid take of BNLL, WY 2010 Interim Flows could still be routed through areas with known BNLL habitat. If the surveys reveal presence of BNLL and no avoidance measures can be identified, agreed on, and implemented, WY 2010 Interim Flows would not be released into the Eastside or Mariposa bypasses.

Avoidance of Vernal Pools, Delta Button-Celery, and Alkali Sink Habitat in the Eastside and Mariposa Bypasses

The release of WY 2010 Interim Flows into the Eastside and/or Mariposa bypasses would depend on the ability to determine that flows would remain within the existing low-flow channel in the bypasses or otherwise would avoid inundating vernal pools, floodplain habitat occupied by Delta button-celery, or alkali sink habitat potentially suitable for palmate-bracted bird’s-beak. Seepage and vegetation monitoring surveys during Interim Flow releases would be used to determine whether Interim Flows need to be reduced to avoid impacts to these species’ habitats.

Invasive Species Management and Monitoring Plan

Within accessibility constraints associated with privately owned lands, comprehensive surveys for invasive nonnative plants will be conducted prior to and following the WY 2010 Interim Flow period during 2009, and 2010 or 2011. At sites where removal are implemented (if any), additional monitoring will be conducted for two years following removal. Survey results and removal will be documented in an Annual Invasive Species Monitoring and Management Report prepared no later than December 31 of each monitoring year.

These surveys will be conducted along the route of the WY 2010 Interim Flows down the mainstem San Joaquin River, between Friant Dam and the Merced River, and the bypass system. Surveys of all publicly accessible lands, Federal or State properties, and properties accessible by collaborating local agencies will be conducted. Instead of additional 2010 surveys, existing survey data may be used for areas previously surveyed during 2008 or 2009.

Surveys will record the distribution of the five invasive species that have been identified as the primary invasive species with potential to compromise the successful implementation of the SJRRP, and that could increase their distribution substantially because of SJRRP operations: giant reed (*Arundo donax*), sponge plant (*Limnobium spongia*), Chinese tallow (*Sapium sebiferum*), red sesbania (*Sesbania punicea*), and salt cedar (*Tamarix* species).

Any new infestations of these species downstream of the extent of the previously known infestations will be controlled and managed. Removal will be species-specific and will also depend on the size of the plants and of the infestation, and may include mechanical removal and limited chemical treatment by hand application. Potential treatments could include the following:

- Red sesbania infestations of a small number of plants (e.g., up to 20 plants) could be removed by mechanical means (hand pulling). Larger infestations of red sesbania could be hand-sprayed with a glyphosate formulation approved for aquatic applications.

- Infestations of giant reed could be controlled by cutting and removing stems, and by hand-treating the plants, or cut or frilled stems, with glyphosate applications.

- Infestations of salt cedar could be hand-treated using chemical control (e.g., imazapyr).

- Treatment of Chinese tallow would depend on plant size. Poles and mature plants could be cut and removed, and stumps could be hand-treated with glyphosate. Seedlings and saplings could be hand-treated directly with glyphosate.

- Infestations of sponge plant could be controlled by mechanical means.

No more than 10 separate vegetation removal crews will operate on any given day for a period of no more than 3 months. Crews may be outfitted with hand tools, chainsaws, and weed whackers. Each crew could employ one heavy piece of equipment (e.g., bobcat or backhoe) and/or one haul truck.

The Proposed Action (including implementation of environmental commitments), would not exceed USEPA's general conformity *de minimis* thresholds or hinder the attainment of air quality objectives in the local air basin. Prior to and during vegetation removal activities that utilize large equipment, fugitive dust emissions would be monitored to determine the need to implement fugitive dust control measures required under San Joaquin Valley Air Pollution Control District (SJVAPCD) Regulation VIII: Fugitive PM10 Prohibitions.

All treated sites will be visited 1 year after the initial treatment, and treated again if necessary. If treated again, the site will be revisited one additional time during the following year and treated a third time, if necessary.

Any herbicide applications will comply with all requirements specified on the product label. Use also will be limited as recommended in the applicable U.S. Environmental Protection Agency interim-measures bulletin for protection of endangered species.

4.0 Environmental Baseline

4.1 Historical Conditions

Typical of Central Valley rivers and a semiarid climate, the natural or “unimpaired” flow regime of the San Joaquin River historically varied greatly in the magnitude, timing, duration, and frequency of streamflows, both interannually and seasonally. Variability in streamflows created conditions that partially helped sustain multiple salmonid life history trajectories, as well as life history phases of numerous resident native fish species and other aquatic species.

The frequency and distribution of habitat types and microhabitat features present in the San Joaquin River before construction of Friant Dam were substantially different from those currently found in the river. In the reach downstream from the current location of Friant Dam, braided channels and side channels were likely very important spawning areas and provided high-quality rearing habitat for fry and juveniles (McBain and Trush 2002). In the unconfined valley reaches, the river flowed through an extensive flood basin that was frequently subject to prolonged inundation, particularly during the spring snowmelt-runoff period.

This description of historic conditions for the three major tributaries of the San Joaquin River – the Merced, Tuolumne, and Stanislaus rivers – is based on reconstructions developed for the Tuolumne River by McBain and Trush (2000). The Tuolumne is the largest of the three main San Joaquin River tributaries, but conditions in all three were likely broadly similar because the tributaries are geographically close and drain geologically and hydrologically similar watersheds. Because of dams, the lower sections of these rivers are the only portions still accessible to anadromous salmonids today.

The natural flow regimes of the Merced, Tuolumne, and Stanislaus rivers historically resulted in much greater variation in the magnitude of streamflows than the current regulated flow regimes. In the Tuolumne River, flow within a given year and between years varied from as little as 100 cfs in summer to peak winter floods exceeding 100,000 cfs. Before flows and sediment were regulated, the lower sections of the rivers behaved alluvially; the channel bed and banks were composed of gravel, cobble, and boulders, and the flow regime and sediment supply were adequate to form and maintain the bed and bank morphology. Before flows were regulated, variability in hydrologic and geological controls, as well as large floods, bedload transport, and channel migration, created dynamic, complex local channel morphologies and diverse riparian vegetation. These processes consistently renewed and maintained high-quality aquatic and terrestrial habitat in the lower reaches of the Merced, Tuolumne, and Stanislaus rivers.

In the lowermost sections of these tributaries, riparian corridors were miles wide. These corridors were sand-bedded and supported lush riparian vegetation. Diversity in plant communities was maintained by a dynamic interaction between initiation, maturation, and mortality of plant stands.

Upstream from the Merced River confluence, natural streambanks along the mainstem San Joaquin River were poorly developed because sediment loads were relatively low, which led to development of vast tule marshes along the river (McBain and Trush 2002). Habitat conditions along the mainstem San Joaquin River downstream from the Merced River confluence, however, were likely similar to those of the lowermost sections of the three primary tributaries. The Merced, Tuolumne, and Stanislaus rivers supplied the sediments required for the formation of relatively stable low- and high-flow channels in the downstream stretch of the San Joaquin River. Those natural streambanks helped provide the conditions required for development of riparian forests like those on the lower sections of the tributaries. Downstream from the Stanislaus River confluence, as the San Joaquin River approached the Delta, extensive tule marsh again bordered the river.

Water quality in the San Joaquin River and its tributaries has changed dramatically in many locations. Although historic water quality data (i.e., data from before construction of Friant Dam) are not available, the rivers presumably provided excellent water quality conditions for native fish, including anadromous salmonids. Cold, clear snowmelt runoff flowing from the granitic upper basins of the southern Sierra Nevada provided optimal conditions for freshwater life-history stages of salmonids in the upper San Joaquin River and its tributaries, and for invertebrate production, the primary food resource for salmonids. The abundant cold water in the upper San Joaquin River basin presumably had high (saturated) concentrations of dissolved oxygen (DO), low salinity, and neutral pH levels. Levels of suspended sediment and turbidity were likely low, even during high-runoff events, because of the upper basin’s mainly granitic geology and the relatively low rates of primary productivity (algae growth).

The Delta is a 600-square-mile area of channels and islands at the confluence of the Sacramento and San Joaquin rivers (Lund et al. 2007). Freshwater draining from a 41,300-square-mile watershed enters the Delta from the Sacramento and San Joaquin rivers and several smaller rivers. This Delta is fundamentally different from other river deltas because it was not formed primarily from deposition of river sediments, but from a combination of river sediments and vast quantities of organic matter deposited by tules and other marsh plants. Accumulation of both types of sediments has kept pace with a slow rise in sea level over the past 6,000 years.

The historical Delta consisted of low-lying islands and marshes. As originally found by European explorers, nearly 60 percent of the Delta was submerged by daily tides, and spring tides could submerge it entirely. Although most of the Delta was a tidal wetland, the water within the interior remained primarily fresh. However, inflow to the Delta from its major tributaries was much more variable than the current regulated flow regime, and salinity intruded much farther inland in the Delta during summer in some years. Inflow in winter and spring was generally higher than under current conditions.

About 350,000 acres of freshwater marsh were present in the Delta before land reclamation efforts began soon after the start of the Gold Rush. The dominant vegetation was tules, but a variety of tree species were established on the natural levees, including oak, sycamore, alder, walnut, and cottonwood.

4.2 Current Conditions

The lower San Joaquin River and the valley sections of its major tributaries—the Merced, Tuolumne, and Stanislaus rivers—have changed dramatically since the early part of the 19th century. These rivers are now largely confined within constructed levees and bounded by agricultural and urban development, flows are regulated by dams and water diversions, and floodplain habitats have been fragmented and reduced in size and diversity (McBain and Trush 2002). As a result, the riparian communities have substantially changed from historic conditions (McBain and Trush 2000, Jones and Stokes Associates 1998a). The presence of Friant Dam on the San Joaquin River and a series of dams on the eastside tributaries reduce the frequency of scouring flows, which has resulted in a gradual decline of bare gravel and sandbar surfaces required to recruit growth of new riparian plants.

The largest dam on the Merced River is New Exchequer Dam, which forms Lake McClure (1 million acre-feet) (USFWS 1995). Downstream from Exchequer Dam is Crocker-Huffman Dam, which prevents further upstream migration of fall-run Chinook salmon. The valley section of the Merced River is characterized by abandoned floodplain terraces (USFWS 2001), which have been developed for agricultural uses, such as row crops, cattle grazing, and orchard crops. Because riparian vegetation has been removed to facilitate these agricultural practices, only a narrow strip of riparian vegetation remains along the incised river channel. The riparian habitat and floodplain have been further disturbed by intensive aggregate mining.

The largest reservoir on the Tuolumne River is New Don Pedro Reservoir (2.0 million acre-feet) (USFWS 1995). Several small reservoirs lie downstream from this reservoir, the lowermost of which is Modesto Reservoir. LaGrange Dam, immediately downstream from Modesto Reservoir, is the upstream barrier to migration of fall-run Chinook salmon. Mining activities and urban and agricultural encroachment on the Tuolumne directly removed large tracts of riparian vegetation, and selective grazing by livestock removed young riparian plants. Regulation of flow and sediment indirectly affected riparian vegetation by modifying the hydrologic and fluvial processes required for a dynamic riparian ecosystem.

The largest dam on the Stanislaus River is New Melones Dam (2.4 million acre-feet) (USFWS 1995). Goodwin Dam, downstream from New Melones, is the upstream barrier for fall-run Chinook salmon migration on the Stanislaus River. Alteration of the natural flow regime and changes in land use practices similar to those described for the Merced and Tuolumne rivers have adversely affected environmental conditions in the lower Stanislaus River.

Delta habitat has been severely affected by the cumulative effect of many past and present actions. More than 95 percent of the Delta's original tidal marshes have been leveed and filled, resulting in losses of aquatic habitat (USGS 2007). The current Delta consists of islands, generally below sea level, that are surrounded by levees to keep water out. Inflow of freshwater into the Delta has been substantially reduced by water diversions, mostly to support agriculture. Dredging and other physical changes have altered flow patterns and salinity (USGS 2007).

The south Delta is perhaps the most degraded portion of the Delta because of large water diversions at Federal and State export facilities located in this region, greatly reduced inflow from the San Joaquin River, and high levels of contaminants from agricultural drainage. Nonnative species have changed and are continually changing the Delta's ecology by altering its food webs. All of the habitat changes have had substantial effects on the Delta's biological resources, including marked declines in the abundance of many native fish and invertebrate species (Greiner et al. 2007). Native fish species in decline include delta smelt, green sturgeon, Central Valley fall-run and spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and Central Valley steelhead.

4.3 Habitat Types in the Action Area

4.3.1 Aquatic Habitat Types

The Action Area encompasses a large variety of aquatic habitats. A 9-mile reach of the San Joaquin River stretches upstream from Millerton Lake to Kerckhoff Dam. This section of river has a bedrock-constrained channel with alternating long, narrow pools and small cascades, poorly developed riparian vegetation, and flow managed by diversions and releases from Kerckhoff Dam. Millerton Lake does not contain any listed aquatic species so is not discussed further in this section.

The section of San Joaquin River between Friant Dam and the Merced River confluence (i.e., SJRRP Reaches 1A through 5) provides generally poor fish habitat conditions. Physical barriers, reaches with poor water quality or no surface flow, and the presence of false migration pathways have reduced habitat connectivity. Habitat complexity between Friant Dam and the confluence with the Merced River is reduced, with limited side-channel habitat or instream habitat structure, and highly altered riparian vegetation. In upstream portions, gravel mining has created pits that provide lentic habitat that may be used by piscivorous species. Bypasses in these reaches receive water sporadically, as necessary for flood control. Most aquatic habitat in the bypasses is therefore temporary, and its duration depends on flood flows; the bypasses are largely devoid of aquatic and riparian habitat because of efforts to maintain hydraulic conveyance for flood flows (McBain and Trush 2002).

Aquatic habitats in the Tuolumne River downstream from LaGrange Dam are influenced by several factors, many of them related to former gold mining activities and gravel mining (McBain and Trush 2000). A 10-mile stretch of the Tuolumne River channel downstream from the dam is constrained by extensive fields of dredge tailings that range from large cobbles to fine sediments, which restrict river meander and access to alluvial sediments. Downstream, the lower gradient river meanders through low hills and valleys bordered by grazing land, tree crops, and irrigated fields of row crops. At approximately 25 miles below La Grange Dam, the river is generally channelized and flows through sandy loam soils. In this lower reach, the Tuolumne River channel is characterized by slow-velocity run habitat with a sandy-silty bottom and no riffles; the area is not suitable for salmonid spawning.

The Merced River is accessible to anadromous fish for the first 51 river miles upstream from the San Joaquin River confluence, with access terminating at Crocker-Huffman Dam (USFWS 2001). Most spawning occurs within a few miles of the dam. In the Stanislaus River, fall-run Chinook salmon spawn in a 23-mile stretch of the Stanislaus downstream from Goodwin Dam, but most spawning occurs in the first 10 miles below the dam.

Habitat conditions in the lower San Joaquin River downstream from the Merced River confluence are similar to those described above for the lowermost section of the Tuolumne River. The river channel is characterized by slow-velocity run habitat with a sandy-silty bottom and no riffles. Riparian habitat is poorly developed. Diversions are numerous in this section, providing water for agricultural and municipal use; some of the applied water is returned as agricultural drainage (Brown and May 2006).

The downstream-most portion of the Action Area is the Delta, which provides highly modified estuarine habitat. Little remains of the Delta’s tidal marshes that once provided vast amounts of aquatic habitat. Current habitat consists primarily of a complex network of interconnected and leveed channels. Vegetation on the levees of some channels provides suitable riparian habitat, but other levees are armored with riprap, which has little value for fisheries habitat. Water development projects have greatly altered the seasonal magnitude, timing, and direction of flows in the Delta, which has adversely affected native species and may have facilitated successful invasions by numerous exotic species. Exotic species currently dominate the Delta’s biotic community.

The Delta is a tidal region, and every 12.4 hours, the tides cause water to move in and out of the Delta (USFWS 2008). Most of the time, tides cause a 5- to 8-mile ebb-and-flow movement of water in the western part of the Delta. The movement of freshwater through the Delta is superimposed on the tidal flows. Typical freshwater flows are much smaller than tidal flows, usually in the range of 5 to 15 percent of the tidal flows. Along a salinity gradient extending from San Francisco Bay into the Delta, the species composition of the aquatic community changes dramatically, although the basic functional relationships among organisms (e.g., predator/prey) remain similar throughout the system.

4.3.2 Terrestrial Habitat Types

The regional vegetation and land cover types are shown in Exhibits 1a-1c.

Millerton Lake and Upper San Joaquin River to Kerckhoff Dam

Plant communities around Millerton Lake are mostly foothill woodlands and grassland, with minor inclusions of willow scrub along the shoreline and riparian forest communities where intermittent drainage channels empty into the lake. Adjacent hillsides support foothill pine–blue oak woodland with abundant grass/forb and shrub understory. Open grassland and savanna-type habitat conditions also exist in some areas. Several large basalt tables known to have vernal pools surround the canyon, well above an elevation of 1,600 feet.

Upland vegetation above Millerton Lake is characterized by foothill pine–oak woodland with areas of open grassland and rock outcroppings. The predominant vegetation is foothill pine, blue oak, and interior live oak. Montane coniferous forest constitutes the higher elevations upstream from Mammoth Pool. Habitat types in this area are meadow, riparian deciduous, lodgepole pine, mixed conifer, ponderosa pine, rock outcrop, and brush (USJRWPA 1982).

San Joaquin River from Friant Dam Downstream to Merced River

Reach 1. Steep bluffs confine the riparian zone for much of Reach 1A (DWR 2002). Reach 1A presently supports continuous riparian vegetation, except where the channel has been disrupted by instream aggregate removal or off-channel aggregate pits that have been captured by the river. This subreach has the highest overall diversity of plant species in the Restoration Area and greatest number of riparian communities: cottonwood, willow, mixed, and oak riparian forest; willow and riparian scrub and elderberry savanna; and emergent wetland (DWR 2002). Large areas occupied by invasive tree species (blue gum and tree-of-heaven) have been recorded in Reach 1A. Giant reed and red sesbania were also recorded (DWR 2002).

Reach 1B is more narrowly confined by levees. Outside of the levees and steep bluffs, land uses are nearly all agricultural. Woody riparian vegetation is prevalent and occurs mainly in narrow strips immediately adjacent to the river channel. Mature vegetation on the backside of many point bars and on low floodplains is scarce. Remnant valley oaks are present on some of the higher terraces. Previously cleared terraces and the understory of the cottonwood and oak stands are dominated by nonnative annual grasses (McBain and Trush 2002). Blue gum, giant reed, red sesbania, and tree-of-heaven are prevalent in Reach 1B. Red sesbania was mapped downstream to River Mile (RM) 242 in 2000, but likely is currently more abundant downstream given its potential to spread rapidly (DWR 2002).

Reach 2. Reach 2 of the San Joaquin River is characterized by seasonal drying of the channel in summer and fall. The water table recedes into the porous substrate, creating a pronounced riparian drought nearly every year (DWR 2002). In most years, the channel is essentially dry most of the year from Gravelly Ford to the Mendota Pool, except under flood release conditions, when up to 2,000 cfs is passed downstream from the Chowchilla Bifurcation Structure (Jones and Stokes Associates 1998b). Cultivated lands occupy nearly all the lands outside the river bottom.

Riparian vegetation in the upper 10 miles of this reach (Reach 2A) is sparse or absent because the river is usually dry and the shallow groundwater is overdrafted (McBain and Trush 2002). Grassland and pasture are relatively abundant in Reach 2A, contributing almost 50 percent to the total natural land cover (excluding urban and agricultural land cover types). The most abundant riparian communities present are riparian and willow scrub habitats. The only significant stand of elderberry savanna mapped in the Restoration Area occurs on the left bank near the Chowchilla Bifurcation Structure, at the junction of Reaches 2A and 2B (DWR 2002). Invasive species recorded in Reach 2A in 2000 included large stands of blue gum and tree-of-heaven (9 acres) and giant reed (6 acres) (DWR 2002). Red sesbania is also widespread in Reach 2A, based on observations made in 2008.

The lower few miles of Reach 2B support narrow, patchy, but nearly continuous vegetation because this area is continuously watered by the backwater of the Mendota Pool. The riparian zone is very narrowly confined to a thin strip 10 to 30 feet wide bordering the channel. The herbaceous understory, however, is very rich in native species, and a high portion of the total vegetative cover is native plants. Invasive species were not mapped in Reach 2B by DWR (2002).

The margins of the Mendota Pool support some areas of emergent vegetation dominated by cattails and tules; a few cottonwoods and willows grow above the waterline.

Reach 3. San Joaquin River Reach 3 is characterized by continuous flow from the Delta-Mendota Canal within a very confined channel, by seasonally low water, and by narrow strips of riparian vegetation along the river's edge. Adjacent lands are mostly in agricultural use, except where the city of Firebaugh borders the river's west bank for 3 miles. The likely reason that the riparian corridor is narrow is that the upper and middle floodplain elevations have been developed for agricultural and urban uses. A reduction in the frequency of lower flood events also likely resulted in less frequent scouring, which has decreased the abundance of early successional riparian vegetation (i.e., scrub) and riverwash (Jones and Stokes Associates 1998b), while allowing the establishment of riparian forest.

Nearly continuous riparian vegetation of various widths and cover types occurs on at least one side of the channel in this reach. In Reach 3, cottonwood riparian forest is the most abundant native vegetation type, followed by willow scrub, willow riparian forest, and riparian scrub. Small amounts (less than 0.5 acre each) of giant reed and nonnative trees were mapped in Reach 3 (DWR 2002).

Reach 4. Reach 4A San Joaquin River is similar to Reach 3 in that the flow is confined within a narrow channel and agricultural land borders the levees. The flows in this subreach are usually negligible because of the diversion at Sack Dam, but periodically flood-control flows are conveyed in such a way as to define a channel through the reach (Jones and Stokes Associates 1998b). The floodplain of the Reach 4B is broader, with levees set back from the active channel. The water table is also closer to the surface than in the other reaches within the Restoration Area (DWR 2002).

Reach 4A is sparsely vegetated, with a very thin band of vegetation along the channel margin (or none at all). Willow scrub and willow riparian forest occur in small to large stands, and ponds rimmed by small areas of marsh vegetation are present in the channel; however, this reach has the fewest habitat types and lowest ratio of natural vegetation per river mile in the Restoration Area.

Reach 4B upstream from the Mariposa Bypass (Reach 4B1) supports a nearly unbroken, dense, but narrow corridor of willow scrub or young mixed riparian vegetation on most of the reach, with occasional large gaps in the canopy. Reach 4B1 no longer conveys flows because the Sand Slough Control Structure diverts all flows into the bypass system. As a result, the channel in Reach 4B1 is poorly defined and filled with dense vegetation, and in some cases, is plugged with fill material.

Because of its wider floodplain and available groundwater, as well as management of the land as part of the San Luis NWR, Reach 4B2 contains vast areas of natural vegetation compared to the upstream reaches. Grasslands and pasture are the most common vegetation type, but willow riparian forest and emergent wetlands are also relatively abundant. Agricultural land uses are greatly reduced relative to other reaches in the Restoration Area (DWR 2002).

Reach 5. Conditions in Reach 5 of the San Joaquin River are similar to conditions in Reach 4B2: The floodplain is broad, less agricultural conversion of natural habitat has occurred than elsewhere in the Restoration Area, and land is held in public ownership and managed for wildlife habitat. The river has more sinuosity in this reach and oxbows, side channels, and remnant channels are present; however, the floodplain and basin are generally disassociated from the mainstem river because of levees constructed as part of the San Joaquin River Flood Control System (McBain and Trush 2002).

In Reach 5, the San Joaquin River is surrounded by large expanses of upland grassland, with substantial woody riparian vegetation in the floodplain. Remnant riparian tree groves are concentrated on the margins of mostly dry secondary channels and depressions or in old oxbows. Along the mainstem San Joaquin River, a relatively uniform pattern of patchy riparian canopy hugs the channel banks as large individual trees or clumps (primarily valley oaks or black willow) with a mostly grassland or brush understory (McBain and Trush 2002).

The most abundant plant community is grassland and pasture, followed by willow riparian forest, emergent wetland, willow and riparian scrub, and willow, oak, and cottonwood riparian forests. Alkali scrub is also present in this reach (DWR 2002).

Eastside and Mariposa Bypasses

Eastside Bypass. Upland vegetation in the Eastside Bypass is grassland and ruderal vegetation (i.e., nonnative herbaceous of disturbed lands). The reach between the Sand Slough Control Structure and the Merced NWR (approximately 4.5 miles) supports several ponds. For the next 2.2 miles, the bypass moves through the Merced NWR, which encompasses more than 10,000 acres of wetlands, native grasslands, vernal pools, and riparian habitat. Farther downstream, the Eastside Bypass passes through the Grasslands Wildlife Management Area, an area of private lands with conservation easements held by USFWS, and through the East Bear Creek Unit of the San Luis NWR Complex. Patchy riparian trees and shrubs occur along the banks of the Eastside Bypass in these areas. Side channels and sloughs (e.g., Duck, Deep, and Bravel sloughs) are present along the lower Eastside Bypass, and some support remnant patches of riparian vegetation.

Mariposa Bypass. The Mariposa Bypass is bordered to the south by agricultural land and vernal pool grasslands to the north. Scattered riparian trees are present along the Mariposa Bypass.

San Joaquin River Downstream from the Merced River Confluence

The San Joaquin River downstream from the Merced River confluence is similar to the river upstream from the confluence, except that the Merced, Tuolumne, and Stanislaus rivers contribute a substantial amount of flow in this area. The upstream portion of the San Joaquin River below the Merced River is more incised than the downstream portion, with generally drier conditions in the riparian zone and a less developed understory.

Agricultural land use has encroached on the riparian habitat along most of the San Joaquin River. Along much of the river, only a narrow ribbon of riparian habitat is supported. However, riparian habitat is more extensive locally, especially near the confluence with tributary rivers, within cutoff oxbows, and in the 6,500-acre San Joaquin River NWR between the confluences with the Tuolumne and Stanislaus rivers. Remnant common tule- and cattail-dominated marshes may occur at these areas.

South Delta

Agriculture dominates the Delta area, with agricultural lands occupying nearly three-quarters of the region’s total land area (CALFED 2000). However, a substantial area of natural vegetation remains, including large areas of sensitive riparian, marsh, and aquatic vegetation, which are described below.

Most riparian vegetation in the Delta is characterized by narrow linear strips of trees and shrubs, in single-story to multistory canopies. Tree canopies may be continuous, discontinuous, or absent altogether (as in riparian scrub). These patches of riparian vegetation typically are on or at the toe of levees. Riparian communities in this region include cottonwood-willow woodland, valley oak riparian woodland, riparian scrub, and willow scrub.

In addition to the wetland communities described for the San Joaquin River, the Delta supports tidal freshwater and brackish-water emergent marshes that, like nontidal marshes, are dominated by clonal perennial plants. This community occurs on instream islands and along most tidally influenced waterways. In addition to the environmental factors affecting marshes outside of the Delta, the species composition of tidal marshes in the Delta is affected by regional salinity gradients.

The Delta supports extensive areas of aquatic vegetation. These communities consist of submerged plants generally rooted in the substrate, whose stems may extend partially above the water surface (e.g., during flowering) and floating plants that generally are not rooted in the substrate. The availability of light (which decreases with depth), turbidity, water velocities, and shade cast by overtopping vegetation can restrict submerged plants to relatively shallow areas. In the Delta (which has turbid waters), most submerged vegetation appears to be restricted to areas less than 5 to 10 feet deep.

Merced, Tuolumne, and Stanislaus Rivers

As mentioned previously, three major rivers are tributary to the San Joaquin River: the Merced, the Tuolumne, and the Stanislaus. These rivers were evaluated for habitat from the respective dam sites to the confluence with the San Joaquin River: the Merced River downstream from New Exchequer Dam, the Tuolumne River downstream from Don Pedro Dam, and the Stanislaus River downstream from New Melones Dam. These rivers originate in the Sierra Nevada foothills and are generally surrounded by foothill pine–oak woodland with an herbaceous understory. As the rivers reach the floor of the Central Valley, the riparian corridor is narrower because of urban development and agricultural land uses.

Along the Merced River, near the community of Snelling, dredge spoils line the river. The dredge spoils support seasonal scrub–shrub wetlands in the concave areas between spoils. Downstream, a wide wash is present along the Merced River floodplain; this area is devoid of woody vegetation, and two oxbow lakes are present in this area. Dredge spoils are also present along the Tuolumne River, near the community of La Grange. The dredge spoils in this location support forested wetlands throughout the spoils area. In addition, dredge spoils are present along the Stanislaus River and support a forested wetland habitat.

4.4 Current Management Direction

The WY 2010 Interim Flows have been developed around existing and ongoing Federal, State, and local efforts intended to protect Federally listed and proposed species within the Action Area. Consultation with USFWS and NMFS regarding the potential effects of the WY 2010 Interim Flows is based on the ESA policy for each resource agency, existing BOs, and other guidance documents and programs as described below.

4.4.1 Central Valley Project Improvement Act

CVPIA amends the authorization of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes of the CVP having equal priority with irrigation and domestic uses of CVP water and elevates fish and wildlife enhancement to a level having equal purpose with power generation. Under the CVPIA, a significant goal identified to meet the new fish and wildlife purposes is the broad goal of restoring natural populations of anadromous fish (Chinook salmon, steelhead, green and white sturgeon, American shad and striped bass) in Central Valley rivers and streams to double their recent average levels.

4.4.2 Anadromous Fish Restoration Program

The Anadromous Fish Restoration Program (AFRP) was developed to comply with Section 3406(b)(1) of the CVPIA. The Secretary of the Interior was directed to:

> *"…develop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less*

> *than twice the average levels attained during the period of 1967–1991…"*

Additionally, Section 3406(b)(1) jointly imparted the responsibilities of implementing the CVPIA to the USFWS and Reclamation although the USFWS has assumed the lead role in the development of the AFRP. The Final Restoration Plan for the AFRP was adopted on January 9, 2001 and will be used to guide the long-term development of the AFRP.

4.4.3 Long-term Central Valley Project and State Water Project Operations Criteria and Plan

The CVP and the SWP are two major inter-basin water storage and delivery systems that divert and re-divert water from the southern portion of the Delta. Both CVP and SWP include major reservoirs upstream of the Delta, and transport water via natural watercourses and canal systems to areas south and west of the Delta. The CVP also includes facilities and operations on the Stanislaus and San Joaquin rivers. The major facilities on these rivers are New Melones and Friant Dams, respectively.

The projects are permitted by the California State Water Resources Control Board (SWRCB) to store water during wet periods, divert water that is surplus to the Delta, and re-divert CVP/SWP water that has been stored in upstream reservoirs. Both CVP and SWP operate pursuant to water right permits and licenses issued by the SWRCB to appropriate water by diverting to storage or by directly diverting to use and re-diverting releases from storage later in the year. As conditions of their water right permits and licenses, the SWRCB requires the CVP and SWP to meet specific water quality, quantity, and operational criteria within the Delta. Reclamation and DWR closely coordinate the CVP and SWP operations, respectively, to meet these conditions.

Because the CVP and SWP operations, including export activities, affect fish and wildlife in the Central Valley, Reclamation consulted with both USFWS and NMFS under Section 7 of the ESA. The most recent consultation has been completed with USFWS for delta smelt (BO published in 2008). NMFS is currently preparing their BO for Sacramento River winter-run Chinook salmon ESU, Central Valley spring-run Chinook salmon ESU, Central Valley steelhead DPS, and North American green sturgeon, with the expected release date in June 2009.

4.4.4 CALFED Bay-Delta Program

CALFED consists of a consortium of Federal and State agency personnel working together to protect the San Francisco Bay/Sacramento-San Joaquin Delta, coordinate CVP and SWP operations, and develop a long-term Bay-Delta solution to address ecosystem restoration. A major element of the CALFED Bay Delta Program is the Ecosystem Restoration Program Plan that is intended to provide the foundation for long-term ecosystem and water quality restoration and protection throughout the region.

4.4.5 Coordinated Operations Agreement

The 1986 Agreement Between the United States of America and the DWR for Coordinated Operation of the CVP and SWP (COA) defines the rights and responsibilities of the CVP and SWP with respect to in-basin water needs and provides a mechanism to measure and account for those responsibilities. In-basin uses are defined in the COA as legal uses of water required under SWRCB Decision 1485 (D-1485), Delta Standards. Since both the CVP and SWP utilize the Delta as common conveyance facilities, reservoir releases and Delta export operations must be coordinated to ensure that the CVP and SWP each retains its share of the commingled water and each bears its share of the joint obligations to protect beneficial uses.

Balanced water conditions are defined in the COA as periods when it is agreed that releases from the upstream reservoirs, plus unregulated flows, approximately equals the water supply needed to meet Sacramento Valley in-basin demands plus exports. Excess water conditions are periods when sufficient water is available to meet all beneficial needs, and the CVP/SWP are not required to make releases from reservoir storage. When water must be withdrawn from reservoir storage under the COA, the CVP is responsible for providing 75 percent and the SWP 25 percent of the water to meet Delta Standards. When unstored water is available for export (i.e., under balanced conditions), and the sum of CVP stored water, SWP stored water, and the unstored water for export is allocated at 55/45 percent to the CVP and SWP, respectively.

The COA has evolved considerably since 1986 with changes to facilities and operating criteria. New flow standards such as those imposed by the SWRCB have revised how projects are operated. Although the burden of meeting these new responsibilities has been worked out internally between the CVP and SWP, the COA has never been officially amended or evaluated for consistency. Previous NMFS BOs have evaluated operations with the internal changes that have taken place in the COA to date.

4.4.6 Recovery Plan for Sacramento-San Joaquin River Delta Native Fishes

In 1996, USFWS released a Recovery Plan for Sacramento-San Joaquin River Delta Native Fishes (USWFS 1996) that included recovery plans for delta smelt, spring-run Chinook salmon, San Joaquin River fall-run Chinook salmon and green sturgeon. The objective of the Recovery Plan is to establish self-sustaining populations of the fishes that will persist indefinitely.

4.4.7 Watershed Protection Program

In 1997, the Watershed Restoration and Protection Council (WRPC) program was established and is composed of all California agencies that have programs addressing anadromous salmonid protection and restoration. The WRPC is charged with overseeing all State activities aimed at watershed protection and enhancement, and directing the development of a Watershed Protection Program that provides for anadromous salmonid conservation in California (http://ceres.ca.gov/watershed/wprc/Final_WPRC_Report.pdf).

4.4.8 Habitat Conservation Plans

NMFS and USFWS are currently assisting in the development of multiple species habitat conservation plans (HCP) for State and privately owned lands. HCPs, which are required under Section 10 of the Federal ESA, address species protection under non-Federal projects. The purpose of the HCP is to ensure that any incidental taking of listed species will not appreciably reduce the likelihood of species survival.

4.4.9 Clean Water Act and Rivers and Harbors Act

Projects requiring a permit from the United States Army Corps of Engineers (USACE), under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (CWA), do not allow the extent of destruction and modification of sensitive species' habitat that occurred prior to the implementation of these regulations. Measures to protect sensitive species are often included as "standard measures" in Section 404 permits. Examples of these measures include eliminating or reducing siltation by installing silt fencing along project sites and access roads, preventing sensitive species from entering the Project Area, erecting cofferdams on either side of project sites, and timing project activities to reduce impacts during the breeding season.

4.4.10 Pacific Coast Salmon Fishery Management Plan

The Pacific Fishery Management Council (PFMC) regulates the offshore sport and commercial fishery for Chinook salmon using its Pacific Coast Salmon Fishery Management Plan (PFMC 2003), which describes the goals and methods for salmon management. Management tools, such as season length, quotas, bag limits, and gear restrictions, vary annually, depending on how many salmon are present. There are two main components to the Plan: (1) an annual goal for the number of spawners of the major salmon stocks ("spawner escapement goals") and (2) allocation of the harvest among different groups of anglers (commercial, recreational, tribal, various ports, ocean, and inland). PFMC must also comply with laws such as the ESA.

4.4.11 California Endangered Species Act

The California Endangered Species Act (CESA) of 1984 allows DFG administers to protect fish and wildlife resources by regulating the listing and "take" of endangered and threatened species. A "take" of such a species may be allowed by DFG through issuance of permits pursuant to Fish and Game Code Section 2081. DFG is empowered to review projects for their potential impacts to listed species and their habitats.

The CESA is similar to the Federal ESA but pertains only to State-listed endangered and threatened species. The CESA requires State agencies to consult with DFG when preparing documents under CEQA to ensure that the actions of the State lead agency do not jeopardize the continued existence of listed species. The CESA directs agencies to consult with DFG on projects or actions that could affect listed species, directs DFG to determine if jeopardy to listed species would occur, and allows DFG to identify "reasonable and prudent alternatives" to the project consistent with conserving the species. Agencies can approve a project that affects a listed species if the agency determines that there are "overriding considerations"; however, the agencies are prohibited from approving projects that would cause the extinction of a listed species. The CESA prohibits the "take" of State-listed as endangered or threatened plant and wildlife species. DFG may authorize take if there is an approved habitat management plan or management agreement that avoids or compensates for impacts on listed species.

4.4.12 The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act

The Salmon, Steelhead, Trout and Anadromous Fisheries Program Act was enacted in 1988. At that time, DFG reported that the natural production of salmon and steelhead in California had declined to approximately 1,000,000 adult Chinook salmon, 100,000 coho salmon, and 150,000 steelhead. In addition, DFG reported that the naturally spawning salmon and steelhead resources of the State had declined dramatically within the past four decades primarily as a result of lost stream habitat on many streams in the State. The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act declares that it is the policy of the State to increase the salmon and steelhead resources, and directs DFG to develop a plan and program that strives to double the salmon and steelhead resources (Fish and Game Code Section 6900).

4.4.13 Steelhead Restoration and Management Plan of California

The goals for steelhead restoration and management outlined in Steelhead Restoration and Management Plan for California (DFG 1996) are: (1) to increase natural production, as mandated by The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act of 1988, in an attempt to create self-sustaining steelhead populations and maintain them in good condition; and (2) to enhance opportunities for angling and non-consumptive uses.

The plan focuses on the restoring of native and wild stocks, as these stocks have the greatest value insofar as maintaining genetic and biological diversity. Suggested strategies to accomplish these two goals include restoring degraded habitat; restoring access to historic habitat that is currently blocked; reviewing angling regulations to ensure that steelhead adults and juveniles are not over-harvested; maintaining and improving hatchery runs, where appropriate; and developing and facilitating research to address deficiencies in information on fresh water and ocean life history, behavior, habitat requirements, and other aspects of steelhead biology.

4.4.14 Porter-Cologne Act

The Porter-Cologne Act, enacted in 1969 and amended in 2005, specifies requirements for water quality protection in California. Under the Porter-Cologne Act, California is required to adopt water quality policies, plans, and objectives that ensure beneficial uses of the State are reasonably protected. The SWRCB and the Regional Water Quality Control Boards (RWQCB) are the agencies with the primary responsibilities of water quality protection and Clean Water Act implementation in California. In their respective regions, the RWQCBs engage in several water quality functions. One of the most important is preparing and periodically updating water quality control plans, which specify the beneficial uses to be protected within a particular region. RWQCBs also regulate all pollutant or nuisance discharges that may affect either surface water or groundwater, including non-point source discharges to surface water. Additionally, the SWRCB, in acting on water rights applications, may establish terms and conditions in water rights permits to help implement water quality control plans.

5.0 Species Accounts

This section presents the status, habitat requirements, and the potential for occurrence of each of the species evaluated in this BA. In addition, critical habitat for each species is discussed if it has been designated and would be affected by the Proposed Action. Recovery and management actions important to the conservation of species are also summarized from existing recovery plans or other information when available.

5.1 Aquatic Species

Listed aquatic species protected under the ESA and described below are the Central Valley steelhead distinct population segment (DPS), delta smelt, Central Valley spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and the North American green sturgeon DPS.

5.1.1 Central Valley Steelhead Distinct Population Segment

The Central Valley steelhead DPS includes all naturally spawned populations of anadromous steelhead below natural and human-made impassable barriers in the Sacramento and San Joaquin rivers and their tributaries, excluding steelhead from San Francisco and San Pablo bays and their tributaries. This species also includes anadromous steelhead from two artificial propagation programs: the Federal Coleman Nimbus Fish Hatchery and State Feather River Fish Hatchery. Central Valley steelhead DPS are listed as threatened (71 *Federal Register* (FR) 834–862, January 5, 2006).

"Steelhead" is the term commonly used for the anadromous form of rainbow trout. NMFS considered including resident *Oncorhynchus mykiss* in listed steelhead DPSs in certain cases (63 FR 13347–13371, March 19, 1998):

- Where resident *O. mykiss* have the opportunity to interbreed with anadromous fish below natural or artificial barriers.

- Where resident fish of native lineage once had the ability to interbreed with anadromous fish but no longer do because they are currently above artificial barriers and are considered essential for the recovery of the DPS.

However, USFWS, which has authority over resident fish under the ESA, concluded that behavioral forms of *O. mykiss* can be regarded as separate DPSs, and that lacking evidence that resident rainbow trout need ESA protection, only anadromous forms should be included in the DPS and listed under the ESA. USFWS also did not believe that the recovery of steelhead would rely on the intermittent exchange of genetic material between resident and anadromous forms. In the final rule, the listing includes only the anadromous form of *O. mykiss* (NMFS 1998).

Moreover, NMFS considers all *O. mykiss* that have physical access to the ocean (including resident rainbow trout) to potentially be steelhead and will treat these fish as steelhead. Microchemical analyses of otoliths taken from rainbow trout in the San Joaquin River Basin have verified that the anadromous form of *O. mykiss* occurs in low numbers in the basin (Zimmerman, Edwards, and Perry 2008).

NMFS is in the process of preparing a recovery plan for all listed Central Valley salmon, including Central Valley steelhead. NMFS issued a recovery outline in 2007, which serves as an interim guidance document until the full recovery plan is released (NMFS 2007). The outline identifies the factors that have led to the decline of the Central Valley steelhead DPS, describes past conservation efforts, and provides a preliminary list of recommended recovery measures. The following measures have been identified for the protection of Central Valley steelhead:

- Conduct and improve monitoring and research on distribution, status, and trends.
- Protect and restore the complexity of watershed and estuarine habitat.
- Implement freshwater habitat restoration techniques as part of construction activities (e.g., setback levees/bar stabilization/levee repair and maintenance, reintroduction of instream woody material (IWM), erosion control).
- Reduce and control impacts of urbanization through education and outreach, partnerships, collaborative teams, and protective regulations.
- Screen water diversion structures in important/priority anadromous fish–bearing streams.
- Collaboratively balance water supply and allocation with the needs of fisheries by improving criteria for water drafting, storage and dam operations, and water rights programs; developing passive diversion devices and/or offstream storage; eliminating illegal diversions in priority watersheds and streams; and facilitating other such opportunities.
- Modify channel and flood control maintenance practices, where appropriate, to increase stream and riparian complexity.
- Identify and treat point- and nonpoint-source pollution to streams from wastewater, agricultural practices, and urban environments.

Historic and Current Distribution

The historic distribution of steelhead in the Central Valley is not known, but in rivers where the species still occurs, steelhead are normally more widely distributed than Chinook salmon (Voight and Gale 1998, cited in McEwan 2001; Yoshiyama et al. 1996). Steelhead are typically tributary spawners.

Lindley et al. (2006) predicted the historical distribution of steelhead, using an Intrinsic Potential habitat model. They found that at least 81 independent populations of *O. mykiss* were widely distributed throughout the Central Valley, but that populations were relatively less abundant in San Joaquin River tributaries than in Sacramento River tributaries because of natural barriers to migration. Also, many small tributaries to the major San Joaquin River tributaries have too high a gradient or too little flow to have supported *O. mykiss*; consequently, steelhead were likely restricted to the mainstems and larger tributaries (Lindley et al. 2006). Around 80 percent of the historical spawning and rearing habitat is now behind impassable dams, and 38 percent of the populations identified by the model have lost their entire habitat (Lindley et al. 2006).

Naturally spawning steelhead populations have been found in the upper Sacramento River downstream from Keswick Dam; in Mill, Deer, and Butte creeks; and in the Feather, Yuba, American, and Mokelumne rivers (McEwan 2001). The steelhead population in the San Joaquin River was extirpated; however, small populations of steelhead persist in the lower San Joaquin River tributaries (i.e., the Stanislaus and Tuolumne rivers and possibly the Merced River) (McEwan 2001). Naturally spawning populations may exist in many other streams but be undetected because of the lack of monitoring or research programs. Steelhead also rear in and migrate through the Delta.

Abundance Trends

NMFS has concluded that populations of naturally reproducing steelhead have been experiencing a long-term decline in abundance throughout their range. Populations in the southern portion of the range have experienced the most severe declines, particularly in streams from the Central Valley south, where many stocks have been extirpated (NMFS 1996a). Since the early 20th century, 23 naturally reproducing populations of steelhead are believed to have been extirpated in the western United States. Many more are thought to be in decline in Washington, Oregon, Idaho, and California. The decline of stocks in California has been particularly steep.

The historic run size of Central Valley steelhead is difficult to estimate given limited data, but may have approached 1 to 2 million adults annually; by the early 1960s, the steelhead run size had declined to about 40,000 adults (McEwan 2001). In the past 30 years, populations of naturally spawned steelhead in the upper Sacramento River have declined substantially. The number of adult steelhead in the Sacramento River upstream from the Feather River was estimated to average 20,540 through the 1960s (Hallock et al. 1961, NMFS 2008). Steelhead counts at Red Bluff Diversion Dam (RBDD) declined from an average of 11,187 for the period of 1967–1977 to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento–San Joaquin system, based on RBDD counts, of no more than 10,000 adults (McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 because of changes in dam operations (NMFS 2008).

The only consistent data available on steelhead numbers in the San Joaquin River basin come from DFG midwater trawling samples collected on the lower San Joaquin River at Mossdale. These data indicate that steelhead numbers declined in the early 1990s and remained low through 2002 (NMFS 2008). In 2004, a total of 12 steelhead smolts were collected at Mossdale. Population numbers of adult Central Valley steelhead present in the San Joaquin tributaries (Stanislaus, Tuolumne, and Merced rivers) are unknown.

Life History

Steelhead exhibit highly variable patterns throughout their range, but are broadly categorized into winter- and summer-run reproductive ecotypes. Winter-run steelhead, the most widespread reproductive ecotype, become sexually mature in the ocean, enter spawning streams in fall or winter, and spawn in winter or late spring (Meehan and Bjornn 1991, Behnke 1992). In the Sacramento River, juvenile steelhead generally emigrate as 2-year-olds (Hallock et al. 1961) in winter and spring (McEwan 2001). Emigration appears to be more closely associated with size than age; most downstream migrants measure 6–8 inches. Downstream migration in unregulated streams has been correlated with spring freshets (Reynolds et al. 1993).

Adult Upstream Migration and Spawning. In the Central Valley, adult winter-run steelhead migrate upstream during most months of the year. Upstream migration begins in June, peaks in September, and continues through February or March (Hallock et al. 1961, Bailey 1954, both as cited in McEwan and Jackson 1996). Spawning occurs primarily from January through March, but may begin as early as late December and may extend through April (Hallock et al. 1961, cited in McEwan and Jackson 1996). In the Central Valley, adult winter steelhead generally return at ages 2 and 3 and range in size from 2 to 12 pounds (Reynolds et al. 1993). Increased water temperatures may trigger movement, but some steelhead ascend into freshwater without any apparent environmental cues (Barnhart 1991).

Although most steelhead die after spawning, adults are capable of returning to the ocean and migrating back upstream to spawn in subsequent years. Runs may include 10 to 30 percent repeat spawners, most of which are females (Ward and Slaney 1988, Meehan and Bjornn 1991, Behnke 1992). Repeat spawning is more common in smaller coastal streams than in large watersheds that require a lengthy migration (Meehan and Bjornn 1991). Hatchery steelhead are typically less likely than wild fish to survive to spawn a second time (Leider et al. 1986). In the Sacramento River, 14 percent of the steelhead were returning to spawn a second time (Hallock 1989). Steelhead may migrate downstream to the ocean immediately after spawning or may spend several weeks holding in pools before outmigrating (Shapovalov and Taft 1954).

Egg Incubation, Alevin Development, and Fry Emergence. Eggs hatch after incubating 20 to 100 days, depending on water temperature (Shapovalov and Taft 1954, Barnhart 1991). Newly hatched steelhead alevins (yolk-sac larvae) remain in the gravel for an additional 14 to 35 days while being nourished by their yolk sacs (Barnhart 1991). Upon emergence, fry inhale air at the stream surface to fill their air bladders, absorb the remains of their yolks, and start to feed actively, often in schools (Barnhart 1991, NMFS 1996b). Survival from egg to emergent fry is typically less than 50 percent (Meehan and Bjornn 1991) but may be quite variable, depending upon local conditions.

Juvenile Freshwater Rearing. Juvenile steelhead (parr) rear in freshwater before outmigrating to the ocean as smolts. The time that parr spend in freshwater appears to be related to growth rate, with larger, faster-growing members of a cohort smolting earlier (Peven, Whitney, and Williams 1994). Steelhead in warmer areas, where feeding and growth are possible throughout the winter, may require a shorter period in freshwater before they smolt, while steelhead in colder, more northern, and inland streams may require 3 or 4 years before smolting (Roelofs 1985).

Juveniles typically remain in their natal streams for at least one summer, dispersing from fry schools to establish feeding territories (Barnhart 1991). Peak feeding and freshwater growth rates occur in late spring and early summer. Juveniles either overwinter in their natal streams, if adequate cover exists, or disperse to other streams as presmolts to seek more suitable winter habitat (Bjornn 1971, Dambacher 1991). When stream temperatures fall below about 44.6 degrees Fahrenheit (°F) in the late fall to early winter, steelhead enter a period of winter inactivity spent hiding in the substrate or closely associated with instream cover, during which time growth ceases (Everest and Chapman 1972). Juveniles' winter hiding behavior reduces their metabolism and food requirements and reduces their exposure to predation and high flows (Bustard and Narver 1975), but substantial mortality still appears to occur in winter.

Smolt Outmigration and Estuarine Rearing. Steelhead migrate downstream to the ocean as smolts, typically at a length of 5.85 to 7.80 inches (Meehan and Bjornn 1991). A length of 5.46 inches is typically cited as the minimum size for smolting (Wagner, Wallace, and Campbell 1963; Peven, Whitney, and Williams 1994). Emigration appears to be more closely associated with size than age; 6 to 8 inches is the most common size of downstream migrants. Downstream migration in unregulated streams has been correlated with spring freshets (Reynolds et al. 1993). However, evidence suggests that photoperiod is the most important environmental variable that stimulates the physiological transformation from parr to smolt (Wagner 1974). During smoltification, the spots and parr marks characteristic of juvenile coloration are replaced by a silver and blue-green iridescent body color (Barnhart 1991) and physiological transformations occur that allow steelhead to survive in salt water.

Less is known about the use of estuaries by steelhead than about use by other anadromous salmonid species; however, available data show that in many systems, steelhead use estuaries as rearing habitat (NMFS 2008). Estuarine rearing may be more important to steelhead populations in the southern half of the species' range because of greater variability in ocean conditions and the paucity of high-quality near-shore habitats in this portion of their range (Bond 2006, NMFS 1996a). Estuaries may also be more important to populations that spawn in smaller coastal tributaries because of the more limited availability of rearing habitat in the headwaters of smaller stream systems (McEwan and Jackson 1996).

Most marine mortality of steelhead occurs soon after they enter the ocean; predation is believed to be the primary cause of this mortality (Pearcy 1992, cited in McEwan and Jackson 1996). Predation mortality and fish size are likely to be inversely related (Pearcy 1992, cited in McEwan and Jackson 1996); therefore, the growth that takes place in estuaries may be very important for increasing the odds of marine survival (Shapovalov and Taft 1954, McEwan and Jackson 1996, NMFS 1996a, Bond 2006).

Steelhead have variable life histories. They may migrate downstream to estuaries as age 0+ juveniles or may rear in streams for up to 4 years before outmigrating to the estuary and ocean (Shapovalov and Taft 1954). Juvenile steelhead may rear in the estuary for 1 to 6 months before entering the ocean (Barnhart 1991). Several studies have shown that estuaries provide valuable rearing habitat to juvenile and yearling steelhead, and are not merely a corridor for smolts migrating to the ocean (Bond 2006, McEwan and Jackson 1996).

Ocean Phase. Most steelhead spend 1 to 3 years in the ocean, and smaller smolts tend to remain in salt water longer than larger smolts (Chapman 1958, Behnke 1992). Larger smolts have been found to experience higher ocean survival rates (Ward and Slaney 1988). Steelhead grow more rapidly in the ocean than in freshwater rearing habitats (Shapovalov and Taft 1954, Barnhart 1991). Unlike other salmonids, steelhead do not appear to form schools in the ocean. Steelhead in the southern part of the species' range appear to migrate close to the continental shelf, and more northern populations may migrate throughout the northern Pacific Ocean (Barnhart 1991).

Factors Affecting Central Valley Steelhead DPS

Environmental factors most likely to affect the abundance and distribution of the Central Valley steelhead DPS are discussed below.

Habitat Loss. The primary factor affecting Central Valley steelhead is the loss of access to suitable habitat. Major dams have blocked access to most steelhead habitat in Central Valley rivers and streams. Passable dams can contribute to migration delays. Hallock (1989) estimated that passage problems at RBDD alone had reduced annual adult steelhead runs in the upper Sacramento River system by approximately 6,000 fish. Subsequent recorded declines in steelhead counts at RBDD may indicate continuing adult migration problems at RBDD.

Flow. Reservoir operations and diversions have altered the natural flow regime of Central Valley streams by changing the frequency, magnitude, and timing of flows. These changes may affect all steelhead life stages. Inadequate instream flows caused by water diversions reduces available habitat and may lead to high water temperatures. Rapid flow fluctuations caused by water conveyance needs and flood control operations may strand redds and young fish.

For steelhead spawning to be successful, flows must provide appropriate water depths and velocities over suitable spawning gravels. Pool tails and riffles riffles with well-oxygenated gravels are often selected for redds (Shapovalov and Taft 1954). Flow also influences water temperature, which is a critical habitat factor for egg incubation (see below).

Suitable flows are necessary year round for juvenile rearing. After they emerge from spawning gravels in spring or early summer, steelhead fry move to shallow-water, low-velocity habitats such as stream margins and low-gradient riffles, and forage in open areas that lack instream cover (Hartman 1965, Everest et al. 1986, Fontaine 1988). As the fry grow, they increasingly use areas with cover and show a preference for flows with higher velocities. Older juvenile steelhead occupy a wide range of hydraulic conditions. A high flow level increases the habitat area available to juvenile steelhead because they commonly use submerged terrestrial vegetation on the channel edge and the floodplain. Greater flow increases average depth, which improves protection from avian and terrestrial predators (Everest and Chapman 1972). In broad low-gradient rivers, changes in flow levels can greatly increase or decrease the lateral area available to juvenile steelhead, particularly in riffles and shallow glides.

Production of fall-run Chinook salmon in the Merced, Tuolumne, and Stanislaus rivers has been shown to be limited by habitat conditions for rearing juveniles and outmigrating smolts (SJRRP 2007a). Similar studies have not been conducted for steelhead, but given that steelhead share many habitat requirements with fall-run Chinook salmon, the relationship is likely true for steelhead.

The stream reaches that are presently accessible to steelhead often lack the summer habitat conditions needed to sustain juvenile steelhead through their freshwater rearing period (NMFS 2008). These conditions can be exacerbated by reservoir operations and water diversions that reduce summer flows, and can be particularly severe in drought years.

Water Temperature. Water temperature is a primary limiting factor for natural steelhead production on many Central Valley streams (NMFS 2008). Although many dams provide downstream releases for fall Chinook salmon, most do not provide cool temperatures for steelhead during summer and fall, especially during critically dry periods (Moyle et al. 2008). Many dams are not able to provide cool water because they were not designed for deep-water reservoir releases or they lack adequate pool storage (McEwan 2001). Where releases of cold water occur throughout the summer, resident populations of trout often develop, supporting fisheries that may affect steelhead.

Spawning Gravels. Egg incubation success (egg hatching and fry emergence) is highly dependent on flow, water temperature, and levels of DO surrounding the developing embryos. Spawning gravels provide the conditions that promote reproductive success by steelhead. Barnhart (1986) reported gravels with high permeability and few fines (less than 5 percent sand and silt by weight) in highly productive steelhead spawning streams. Moyle (2002) reported that steelhead redds are constructed primarily in riffles that consist of coarse gravels. Most natural production of steelhead occurs in tributaries to the upper Sacramento River because spawning in the mainstem river is limited by the paucity of smaller gravel (Reynolds, Reavis, and Schuler 1990).

Dams have reduced or prevented the recruitment of spawning-size gravel to downstream riffles. Riffles downstream from dams are anticipated to continue to degrade as flood flows move gravel downstream without replenishment from upstream areas. Superimposition of redds may occur when spawning gravels are insufficient, leading to reduced spawning success.

Bank Modification and Loss of Riparian Habitat. Nearshore aquatic and riparian habitats have been degraded by the loss of riparian vegetation and streambank modification resulting from agricultural conversion, levee construction and maintenance, channelization, bank protection, and other land use activities in many Central Valley rivers. Such degradation has occurred along the middle and lower reaches of the Sacramento River and its major tributaries and the eastside tributaries of the San Joaquin River. Riparian vegetation along the Sacramento River is highly fragmented and constitutes less than 50 percent of its historical extent (California Resources Agency 1989). An inventory of river's-edge riparian habitat along the lower Sacramento River and Delta channels indicated a 22- to 26-percent reduction in such habitat since 1972, most of which was attributed to bank protection activities (California Resources Agency 1989). Riparian forest along the Tuolumne River is estimated to constitute less than 15 percent of its original extent (McBain and Trush 2000).

Dam construction, streambank modifications, removal of riparian vegetation, and other watershed activities have led to an overall decrease in the amount of IWM input into the riverine systems. IWM plays a variety of important ecological roles. The quality and quantity of fish habitat are directly enhanced by the presence of IWM, which provides overhead cover and additional instream structure (Lisle 1986, Everett and Ruiz 1993). Benefits of IWM in streams include the retention of organic debris, such as salmon carcasses (i.e., nutrient retention); the creation of cover between redds; and the creation of additional habitat for aquatic macroinvertebrates, a major component of fish diets. The abundance of salmonids is often positively associated with the abundance of IWM in a river (Bisson et al. 1987, Hartman and Brown 1987). In streams, IWM creates a diversity of hydraulic gradients that increases microhabitat complexity, especially beneficial for the early life stages of salmonid species.

Shaded riverine aquatic habitat, defined as the nearshore aquatic area at the interface between a river and adjacent woody riparian habitat, provides high-value feeding areas, escape cover, and reproductive cover for numerous fish species, including steelhead (USFWS 1992a). Riparian vegetation and other features of naturally eroding streambanks provide high-value rearing habitat for juvenile steelhead. Overhanging vegetation and banks moderate local water temperatures and provide shade, direct inputs of food (primarily terrestrial insects), and cover from predators.

Because of its unique biological attributes and its increasing scarcity throughout the Sacramento River system, shaded riverine aquatic cover has been designated a Resource Category 1, which is defined as "unique and irreplaceable on a national basis or in the ecoregion" (USFWS 1992a). A Category 1 designation requires project proponents, such as Reclamation, to actively seek impact avoidance and mitigation measures that result in no loss of existing habitat value.

Delta Exports and Entrainment. Water diversions reduce the survival levels of emigrating juvenile steelhead by causing direct losses at unscreened or inadequately screened diversions and indirect losses associated with reduced streamflows. Fish screening and salvage efforts at major agricultural diversions have met with variable levels of success, and many smaller unscreened or inadequately screened diversions continue to operate. Fish losses at diversions can result from physical injury, impingement, entrainment, or predation. Delayed passage, increased stress, and increased vulnerability to predation also contribute to mortality caused by diversions. Diversion impacts on anadromous fish depend on diversion timing and magnitude, river discharge, life stage, and other factors.

Diversions in the Delta entrain juvenile steelhead (Reclamation 2008). The CVP and SWP export facilities in the south Delta have fish screens used to salvage fish greater than a certain size (believed to be about 20 millimeters), but many of the salvaged fish are assumed not to survive their return to the Delta (Kimmerer 2004). Losses at the facilities have been shown to contribute to recent declines of steelhead (Reclamation 2008). Diversions reduce fitness not only by resulting in mortality from entrainment, but also by changing flow patterns that affect straying levels by upstream-migrating adults and outmigrating smolts.

Hatchery Operations. Four hatcheries in the Central Valley—Coleman National Fish Hatchery, Feather River Fish Hatchery, Nimbus Hatchery, and Mokelumne Hatchery—raise steelhead, producing an average of 1.5 million yearlings per year (McEwan 2001). Hatchery production can negatively affect fish populations by leading to a loss of genetic integrity primarily through hybridization, inbreeding, and random genetic change (drift). Hybridization presumably creates individuals that are less well-adapted to local conditions than either parent. Inbreeding results from the breeding of closely related individuals, and is likely to develop from hatchery production because eggs and milt are obtained from relatively few individuals. A small breeding population may also lead to genetic drift. Both inbreeding and genetic drift can lead to the production of individuals that are less well-adapted than naturally produced fish to the natural environment in which the species evolved.

The following are other potentially negative effects of producing hatchery fish:

- Displacement of wild steelhead juveniles through competition and predation.
- Competition of hatchery adults with wild adults for limited spawning habitat.
- Stimulation of sport and/or commercial harvest efforts, which could increase the harvest rate of naturally produced steelhead.
- An increase in the rate of disease among naturally produced fish.
- Negative social interaction between hatchery and wild steelhead.

These first two effects are well-documented for salmonids and may explain why only an estimated 10 to 30 percent of returning steelhead in the upper Sacramento River are of wild origin (Reynolds, Reavis, and Schuler 1990).

Altered Pathways for Adult and Juvenile Migration Through the Delta. Central Valley steelhead adults migrate upstream through the Delta primarily from November through January. Steelhead smolts emigrate through the Delta toward the ocean in spring, with migrations peaking during April and May. The Sacramento and San Joaquin rivers provide the most direct routes for adult migration through the Delta. When adult or juvenile steelhead stray from these channels, their migrations are delayed, and their exposure to stressful habitat conditions (e.g., warm water temperatures, predation, inadequate food resources) may increase.

Sacramento River water may be transported into the lower San Joaquin River via the Delta Cross Channel (DCC), Georgiana Slough, and Threemile Slough, and at the confluence of the Sacramento and San Joaquin rivers. The following factors affect the proportion of Sacramento River water drawn into the lower San Joaquin River:

- Diversions from and inflow to the Delta east of the Sacramento River.
- The position of the DCC gates.
- Tidal exchange patterns.
- Sacramento River discharge.

When the water mass in the lower San Joaquin River in the Delta consists primarily of Sacramento River water, adult steelhead that would spawn in the Sacramento River may be attracted to the south Delta, and migration may be delayed or blocked until the adults find their way back to the Sacramento River (Hallock et al. 1970).

Sacramento River juvenile steelhead enter the Delta via the Sacramento River during migration to the ocean. As stated above, the most direct route through the Delta is the Sacramento River channel. However, some steelhead juveniles may be drawn along an alternate route through the DCC and Georgiana Slough, resulting in delayed migration and an increase in losses caused by diversions and predation. Studies have demonstrated that survival levels of hatchery-reared fall-run Chinook salmon smolts that migrate directly down the Sacramento River are higher than those of smolts that migrate via the channels that connect to the San Joaquin River (Brandes and McLain 2001). Migration of Chinook salmon juveniles through the DCC and Georgiana Slough exposes them to increased predation, higher temperatures, additional agricultural diversions, and complex channel configurations (potentially delaying or preventing seaward migration). Juvenile steelhead may be similarly affected.

When San Joaquin River inflow to the Delta is less than export levels at the CVP and SWP pumps in the south Delta, or when Old River near Mossdale is closed with a barrier, flows in Old and Middle rivers north of the facilities are reversed (i.e., flow toward the south). Reverse flows in Old and Middle rivers may adversely affect juvenile steelhead migrating through the Delta because they may stray from the Sacramento River to the San Joaquin River (Brandes and McLain 2001).

Migration pathways through the Delta for San Joaquin River steelhead are more directly affected by altered flow patterns. Reverse flows in Old and Middle rivers are believed to affect steelhead from the San Joaquin River by altering the environmental cues used by the migrating fish (Mesick 2001). As a result, the juveniles are more vulnerable to being entrained by the pumps, and migrations of both adults and juveniles are delayed. Reverse flows are likely to cause increased straying of migrating adults into the south Delta, where their progress may be impeded by barriers and irregular flow patterns (Mesick 2001).

Inflow from the San Joaquin River affects steelhead movement through the south Delta, which is generally considered to have relatively poor rearing habitat conditions (Nobriga et al. 2008; Monsen, Cloem, and Burau 2007; Feyrer 2004). High inflows likely reduce straying of all life stages from the San Joaquin River channel into channels that lead toward the south Delta pumps. Higher inflows likely reduce the transit time of smolts through the Delta, thus reducing their time of exposure to predators, poor water quality, low food supply, and other mortality factors. Higher inflows may also provide stronger environmental cues for adult fish migrating upstream and smolts and other juveniles migrating downstream (Mesick 2001).

Inflow also affects water quality conditions in the south Delta. DO levels at the Stockton Deep Water Ship Channel (DWSC) are often low during late summer and early fall because of high water temperatures, algal biomass, and low river flow (Giovannini 2005, Lee and Jones-Lee 2003). Migrations of adult San Joaquin River salmon are often delayed by low DO levels near the Stockton DWSC (Giovannini 2005). Migrations of adult steelhead may also be affected, although steelhead adults migrate later in the year than fall-run Chinook salmon, when water temperature and DO conditions at the Stockton DWSC are generally much improved.

Sportfishing. Harvest of naturally spawned steelhead is prohibited within the Central Valley. Take is limited to one hatchery fish per day, and every hatchery fish is marked. Because hatchery fish are raised for harvest and are not particularly suitable to augmentation of wild stocks, their catch is not a detriment to the steelhead population as a whole. It is not clear what effect the incidental catch and release of wild steelhead has on the Central Valley steelhead population as a whole; however, some mortality likely occurs, which could be deleterious as wild fish numbers continue to decline and a greater percentage of the fish are caught and released.

Ocean Phase. Little is known about the use of ocean habitat by steelhead, although changes in ocean conditions are important for explaining trends among populations of steelhead along the Oregon coast (Kostow 1995). Evidence suggests that increased ocean temperatures associated with El Niño events may increase ocean survival as much as twofold (Ward and Slaney 1988). The magnitude of upwelling, which determines the amount of nutrients brought to the ocean surface and which is related to wind patterns, influences ocean productivity, with substantial effects on steelhead growth and survival (Barnhart 1991). Steelhead appear to prefer ocean temperatures of 48 to 53ºF and typically swim in the upper 30 to 40 feet of the ocean’s surface (Barnhart 1991).

5.1.2 Delta Smelt

Delta smelt are endemic to the Delta (Moyle 2002). USFWS listed delta smelt as threatened (58 FR 12854–12864, March 5, 1993). In response to a petition received on March 9, 2006, from the Center for Biological Diversity, the Bay Institute, and the Natural Resources Defense Council, USFWS is currently considering information to determine whether the listing status should be upgraded from threatened to endangered (73 FR 74674–74675, December 9, 2008).

Critical habitat for delta smelt includes all of Suisun Bay, including the contiguous Grizzly and Honker bays; Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the Delta (59 FR 65256–65279, December 19, 1994).

USFWS issued the *Recovery Plan for the Sacramento–San Joaquin Delta Native Fishes* (USFWS 1996d). The recovery plan calls for the Delta to be managed to improve habitat for native fishes in general, with an emphasis on delta smelt. Recovery of delta smelt consists of population and habitat restoration, leading to delisting of the species. Delta smelt will be considered restored when the population abundance and distribution of the species return to levels that existed during the 1967 to 1981 period, as determined by criteria related to DFG's fall midwater trawl surveys. Determination of the species' recovery status includes a 5-year evaluation period that includes very high and low Delta outflow conditions, comparable to those that preceded their listing. Delta smelt will be considered for delisting when the species meets designated recovery criteria under the 5-year evaluation conditions, and when measures are in place to ensure their continued existence.

In 2004, USFWS completed the 5-year status review for delta smelt and concluded that the threats described in the original listing remained: destruction and modification of habitat resulting from extreme outflow conditions, operations of the CVP and SWP projects, and other water diversions. The review concluded that numbers of delta smelt risk falling below the effective population size and that, therefore, the Federal listing of delta smelt as a threatened species continued to be warranted (USFWS 2004).

Historic and Current Distribution

Delta smelt spend their entire lives in the Delta, Suisun Bay, and when Delta outflow is high, the eastern portion of San Pablo Bay. Their abundance has declined greatly in recent years, but their overall distribution is essentially unchanged (USFWS 2008). Under normal outflow conditions, delta smelt aggregate most of the year in the western Delta and eastern Suisun Bay to forage, and adults migrate upstream in winter to spawn in freshwater of the upper Delta. During periods of high Delta outflow, they also spawn in Suisun Marsh channels and the Napa River (Bennett 2005). Spawning adults and larvae have been found throughout the Delta, but they are typically most abundant in the northern, western, and central Delta (Bennett 2005).

Abundance Trends

Delta smelt have always varied in abundance from year to year, but they were once one of the most common fish species in the Delta (USFWS 2008). Numerous factors have likely contributed to a decline in the abundance and range of delta smelt:

- Hydraulic mining in the upper watershed of several of the tributaries of the Sacramento and San Joaquin rivers, which altered sediment and flow patterns in the Delta.

- Construction of levees in the Delta, which resulted in a loss of seasonally flooded habitats and further changed flow patterns.

- Introduction of exotic fish and invertebrate species, which compete with delta smelt for zooplankton, compete with the preferred prey of delta smelt for algae, or prey on the smelt.

- Reduced water quality, which affects both delta smelt and its prey.

- Water exports, which entrain smelt, radically change natural flow patterns in the Delta, and adversely affect the location of the low-salinity zone (LSZ).

The LSZ is a shifting area of low salinity, and is a habitat for a suite of specialized organisms that survive in its unique confluence of freshwater and marine influences (Kimmerer 2004). The LSZ centers around 2 practical salinity units and ranges from about 6 practical salinity units down to 0.5 practical salinity unit. According to seven abundance indices designed by the Interagency Ecological Program for the San Francisco estuary to record trends in abundance, the population of delta smelt has been consistently low relative to historical levels of abundance for several years (USFWS 2008). For example, the summer tow-net survey has recorded relatively low levels of abundance since 1983, with only a few exceptions. In addition, results from the fall midwater trawl surveys indicate that the abundance has declined irregularly over the past 20 years. In recent years, the abundance of delta smelt has declined even further, including record low delta smelt abundance indices since 2002. The recent decline has occurred despite relatively high Delta inflow conditions during several years. In addition to declines in delta smelt and other fish species, abundance trends for many zooplankton species that are important prey for numerous life stages of delta smelt have also declined.

Life History

As mentioned previously, delta smelt complete their life cycle entirely within the Delta and the seaward estuary. Occasionally, delta smelt are found in the Sacramento and San Joaquin rivers upstream from the Delta. Most delta smelt live for only a year, but a small proportion of adults survive to spawn in a second year (Moyle 2002). They are pelagic, inhabiting open water away from the shoreline and bottom. Delta smelt tolerate a relatively broad range of salinities, aggregating in brackish water (the LSZ) during most of the year, and migrating into freshwater to spawn.

Adult delta smelt begin their spawning migrations, which may last for several months, during December or January. Spawning location varies from year to year, depending in part on Delta inflows (Bennett 2005). In recent years, concentrations of larvae have been found in Cache Slough and the Sacramento DWSC in the north Delta, although spawning also occurs in the lower Sacramento and San Joaquin rivers (USFWS 2008). In years of high Delta outflow, delta smelt may spawn in Suisun Marsh or the Napa River, a tributary of San Pablo Bay. The upstream migration seems to be triggered or cued by abrupt changes in flow and turbidity associated with the first flush of winter rain, but can also occur after very high flood flows have receded (USFWS 2008). Spawning occurs from February through June, with peak spawning in April and May (Bennett 2005).

Spawning generally begins when water temperatures approach 54ºF and ceases when they are around 64ºF (USFWS 2008). Spawning has never been observed in the wild, but sand and gravel are believed to be preferred spawning substrates (Bennett 2005). Eggs sink to the bottom and attach to the substrate.

Egg incubation takes 7 to 18 days, depending on water temperature, and larvae begin feeding 4 to 6 days later (Bennett 2005). Larval smelt feed on small zooplankton. Larvae and juveniles gradually move downstream toward rearing habitat in the LSZ (indexed as X2, which is defined as the distance from the Golden Gate Bridge where water salinity is 2 parts per thousand (ppt)), where they reside until the following winter (Moyle 2002). The juveniles typically begin to appear in the population in May, and may remain in upstream portions of the Delta for about a month, particularly during years with low Delta inflow. The location of the delta smelt population follows changes in the location of the LSZ, which depends primarily on Delta outflow.

Factors Affecting Delta Smelt

Flow. Delta flows have major effects on delta smelt. Except under flood flow conditions, the largest flows in the Delta are tidal flows, which far exceed other flows in most Delta channels, but the nontidal flows determine the net direction of water movement and therefore strongly affect the distribution of delta smelt.

Spring storage of runoff in upstream reservoirs, summer reservoir releases for agriculture, and large-volume exports from the CVP and SWP facilities in the south Delta have been especially instrumental in altering the natural spatial and temporal flow patterns of the Delta. The CVP and SWP pumps have a strong effect on distributions of delta smelt in the south Delta because the exports often cause water to flow upstream (i.e., reverse flow). Reverse flows in the south Delta make delta smelt more vulnerable to entrainment at the pumps and create conditions that delay migrations. Reverse flows are believed to affect fish movements by direct transport of weak swimmers such as larval fish (Monson et al. 2007, Kimmerer 2004), and by inappropriate environmental cues for migrating adult fish.

Elevated Delta inflows counteract the negative effects of the export pumps on flow patterns, providing appropriate environmental cues for upstream-migrating adults and successfully transporting newly hatched larvae to the LSZ. Extreme flood flows may be catastrophic, however, because delta smelt and their food resources can be flushed out of the ecosystem entirely.

Delta outflow largely determines the location of X2 and the LSZ, which is an area that historically had high prey densities and other favorable habitat conditions for rearing delta smelt (Kimmerer 2004). The LSZ is believed to provide the best combination of habitat conditions when X2 is located downstream from the confluence of the Sacramento and San Joaquin rivers. When Delta outflow is low, X2 is located in the relatively narrow channels of these rivers, whereas at higher outflows it moves downstream into more open waters (Kimmerer 2004).

Delta smelt may be vulnerable to reverse flows and entrainment in south Delta pumps at any time during their lives; however, they are especially vulnerable as mature adults during spawning migrations, especially in the central or south Delta, and as larvae before their downstream migration. However, in years of low Delta outflow, when the LSZ is located upstream from the confluence of the Sacramento and San Joaquin rivers, all life stages of delta smelt may be subject to the influence of reverse flow and movement into the south Delta.

Temperature. The south Delta often has poor water temperatures for delta smelt, especially during late summer and early fall (Nobriga et al. 2008, Feyrer 2004, Kimmerer 2004). Water temperature is high relative to other parts of the Delta, presumably because it receives inflow from the San Joaquin River directly, which is likely to be somewhat warmer than the Sacramento River, and because of a longer residence time for water in the south Delta.

Entrainment. The Jones and Banks export facilities are the largest diversions in the Delta, and entrain millions of fish each year, including adult, juvenile, and larval delta smelt (Reclamation 2008). The facilities have fish screens used to salvage fish greater than a certain size (believed to be about 20 millimeters), but many of the salvaged fish are assumed not to survive the return to the Delta (Kimmerer 2004) because they are delicate. Losses at the export facilities have been shown to contribute to recent declines of delta smelt (Kimmerer 2008). Diversions reduce fitness not only by resulting in mortality from entrainment, but also by changing flow patterns that determine how delta smelt and important habitat variables are distributed in the Delta. Power plants, municipal diversions, and hundreds of agricultural diversions in the Delta are also responsible for entraining delta smelt.

Contaminants. Toxic chemicals such as mercury, selenium, and pesticides are a concern for Delta fishes, although their effect on delta smelt is uncertain (Bennett 2005). Recently, high levels of ammonium from the Sacramento Regional Wastewater Treatment Plant discharge have been suggested as a possible cause of reduced productivity of the food web supporting delta smelt (Dugdale 2008).

Predation. Delta smelt are vulnerable to predation by striped bass, largemouth bass, and other piscivorous fish species. The larvae are vulnerable to predation by many other fishes, including inland silversides and juvenile Chinook salmon and steelhead (Bennett 2005). Predation rates for delta smelt are likely higher in the south Delta than in other parts of the Delta for several reasons:

- Turbidity is generally lower in the south Delta, and therefore fish are more visible to their predators (Nobriga et al. 2008; Feyrer, Nobriga, and Sommer 2007).

- Many of the structures and facilities in the south Delta, particularly Clifton Court Forebay and the fish louver screens at the Jones and Banks facilities, concentrate or disorient prey fish and provide ambush sites for predacious fish (Reclamation 2008).

- Recent invasions by the submerged plant Brazilian waterweed (*Egeria densa*) provide favorable habitat conditions for black bass species, which prey heavily on young fish life stages (Nobriga and Feyrer 2007, Nobriga et al. 2005).

Food Resources. Juvenile and adult smelt eat primarily copepods, but they also prey on cladocerans, mysids, amphipods, and larval fish (Bennett 2005). During the 1970s and 1980s, delta smelt diets were dominated by zooplankton (*Eurytemora affinis*, *Neomysis mercedis*, and *Bosmina longirostus*), but none of these are currently important prey (USFWS 2008). When delta smelt diets were examined again between 1988 and 1996, they were consistently dominated by the copepod *Pseudodiaptomus forbesi*, which was introduced and became abundant after the invasion of Suisun Marsh by the overbite clam. More recent introductions of copepod species have adversely affected delta smelt feeding (USFWS 2008).

Introduction of the overbite clam to the Delta in 1986 was followed by a dramatic decline in algae production. The clam does not encroach into freshwater, but its grazing effect does, presumably because of the tides. The clam has reduced the standing crop of algae to fractions of historic levels, which has contributed to declines in the abundances of many zooplankton and fish species, but the contribution to delta smelt's decline is uncertain (Kimmerer 2002, Bennett 2005).

Pseudodiaptomus was historically most abundant in the LSZ, but abundances of *Pseudodiaptomus* and other important prey species of delta smelt in the LSZ have declined in recent years, presumably because the overbite clam is now abundant in Suisun Bay and the lower Delta. As previously indicated, the LSZ is typically located near the juncture of the Delta and Suisun Bay. During this period, *Pseudodiaptomus* has increased in the south Delta, where it is now more abundant than in the LSZ. Because of the elevated risks of entrainment and predation, the south Delta is not good foraging habitat for delta smelt. However, *Pseudodiaptomus* produced in the south Delta may be transported to other areas where it would be a potentially important food resource for delta smelt.

5.1.3 Sacramento River Winter-Run Chinook Salmon

The Sacramento River winter-run Chinook salmon is designated as an endangered species under the Federal ESA (59 FR 440, January 4, 1994). In 2004, NMFS evaluated whether Sacramento River winter-run Chinook salmon were still in danger of extinction and proposed downgrading the species' status to threatened; however, after review, NMFS determined that protective measures in place were not enough to alter the level of extinction risk and determined that the status should remain endangered (70 FR 170, September 2, 2005). Designated critical habitat for the Sacramento River winter-run Chinook salmon does not overlap the Action Area, but winter-run salmon are known to stray into the Action Area from the Delta portion of the Sacramento River.

NMFS is preparing a recovery plan for all listed Chinook salmon in the Central Valley. NMFS issued a recovery outline in 2007, which serves as interim guidance until the full recovery plan is released. The outline identifies the factors that led to the decline of the evolutionarily significant units (ESU) and DPSs, describes past conservation efforts, and provides a preliminary list of recommended recovery measures. Some of the measures listed are provided in the species account for Sacramento River winter-run Chinook salmon.

Historic and Current Distribution

Sacramento River winter-run Chinook salmon historically migrated all the way to the upper reaches of the Sacramento River and its tributaries, but barriers now restrict winter-run Chinook salmon to the river below Keswick Dam. Spawning occurs primarily in the Sacramento River upstream from RBDD. Adult and juvenile winter-run Chinook salmon migrate through the Delta and Suisun, San Pablo, and San Francisco bays.

Abundance Trends

Historical winter-run populations of Sacramento River winter-run Chinook salmon approached an estimated 100,000 fish in the 1960s, but declined to fewer than 200 fish in the 1990s (NMFS 2008). In recent years, population estimates of winter-run from carcass surveys included a high of 17,334 in 2006, followed by a precipitous decline in 2007 to 2,488 and a preliminary estimate of 2,850 in 2008 (NMFS 2008).

Life History

Sacramento River winter-run Chinook salmon have life history traits similar to steelhead. Because only adults and juveniles occur in the Action Area, only these two life stages are discussed below.

Upstream Migration. Adult winter-run Chinook salmon leave the ocean and migrate through the Delta into the Sacramento River from November through July. They migrate upstream past RBDD on the Sacramento River from mid-December through July, with most of the spawning population having passed RBDD by late June (69 FR 237, December 10, 2004).

Juvenile and Smolt Emigration. Juvenile winter-run Chinook salmon rear in and emigrate through the Sacramento River and its tributaries from July through March (Hallock and Fisher 1985). Juveniles descending the Sacramento River above RBDD, from August through October and possibly November, are mostly presmolts. Juveniles have been observed in the Delta from October through December, especially when Sacramento River discharge is high because of fall and early-winter storms. Juvenile Chinook salmon move into downstream habitats in response to many factors, such as inherent behavior, habitat availability, flow, competition for space and food, and water temperature. The number of juveniles and the timing of their movement are highly variable. Storm events and the resulting high flows appear to trigger movement by substantial numbers of juveniles to downstream habitats. In general, the abundance of juvenile Chinook salmon in the Delta increases as flows increase (USFWS 1996).

Factors Affecting Sacramento River Winter-Run Chinook Salmon

Environmental factors most likely to affect the abundance and distribution of the Sacramento River winter-run Chinook salmon ESU are discussed below.

Flow. Reservoir operations have altered the natural flow regime of Central Valley streams by changing the frequency, magnitude, and timing of flows. These changes may affect all winter-run Chinook salmon life stages. Changes in the magnitude and timing of reservoir releases can influence the timing of migration by winter-run Chinook salmon.

Suitable flows are necessary for juvenile rearing. A high flow increases the rearing area available to juvenile Chinook salmon because they commonly use submerged terrestrial vegetation on the channel edge and the floodplain. Deeper inundation provides more overhead cover and protection from avian and terrestrial predators than shallow water (Everest and Chapman 1972). In broad low-gradient rivers, changes in flows can greatly increase or decrease the lateral area available to juvenile Chinook salmon, particularly in riffles and shallow glides.

Temperature. Deleterious water temperatures during spawning, incubation, and early rearing periods restrict the winter-run salmon to the Sacramento River primarily upstream from RBDD. Survival of juveniles begins to decline substantially at temperatures above 65°F. During the period when juvenile winter-run Chinook salmon migrate through the Delta, water temperature is generally below 60°F. Therefore, winter-run salmon juveniles likely do not experience a high magnitude of loss as a result of Delta water temperatures (USFWS 1996).

Barriers to Fish Passage. Sacramento River winter-run Chinook salmon historically spawned in the upper Sacramento River and its major tributaries, the McCloud and Pit rivers. The construction of Shasta Dam blocked access to historical habitat and restricted spawning to the mainstem Sacramento River immediately downstream.

Operation of RBDD is considered one of the primary causes of the reduction in abundance of winter-run Chinook salmon. RBDD is a barrier to upstream-migrating adults, preventing up to 40 percent of the winter-run Chinook salmon from passage upstream and delaying the remaining fish for several days (USFWS 1988, Hallock 1983). Salmon that are delayed may suffer reduced fecundity. Winter-run that do not migrate upstream past RBDD do not spawn successfully during most years because of elevated water temperatures (Hallock 1983).

Since 1986, the RBDD gates have been raised during winter and early spring as part of a protection program for winter-run Chinook salmon, thereby reducing delays and blockage of adults. Improved passage through RBDD after 1986 has not reversed the decline in abundance, however. Abundance increased in 2005 and 2006, but this increase may have been the result of ocean conditions or other factors.

Altered Pathways for Adult and Juvenile Migration Through the Delta. The most direct route through the Delta for migrating adult winter-run Chinook salmon is the Sacramento River channel. Sacramento River water may be transported into the lower San Joaquin River via the DCC, Georgiana Slough, and Threemile Slough, and at the confluence of the Sacramento and San Joaquin rivers. The following factors affect the proportion of Sacramento River water drawn into the lower San Joaquin River:

- Diversions from and inflow to the Delta east of the Sacramento River.
- The position of the DCC gates.
- Tidal exchange patterns.
- Sacramento River discharge.

When most of the water mass in the lower San Joaquin River originates from the Sacramento River, adult winter-run Chinook salmon may be attracted to the south Delta, delaying their migration (Hallocket al. 1970).

The effect of delay on spawning conditions depends on the duration of delay and the condition of females during the spawning migration. Winter-run Chinook salmon females usually pass through the Delta in green condition (i.e., before eggs mature) and the eggs ripen months after the salmon arrive in their natal spawning area.

Juvenile winter-run Chinook salmon enter the Delta via the Sacramento River during migration to the ocean. As stated above, the most direct route through the Delta is the Sacramento River channel. However, some winter-run Chinook salmon juveniles are drawn along an alternate route through the DCC and Georgiana Slough, resulting in delayed migration and an increase in losses caused by diversions and predation. Studies have demonstrated that survival of hatchery-reared fall-run Chinook salmon smolts that migrate directly down the Sacramento River is higher than that of smolts that migrate via the channels connecting to the San Joaquin River (Brandes and McLain 2001). Migration of Chinook salmon juveniles through the DCC and Georgiana Slough exposes them to increased predation, higher temperatures, additional agricultural diversions, and complex channel configurations that may delay or prevent seaward migration. Juvenile winter-run Chinook salmon may be similarly affected.

When San Joaquin River inflow to the Delta is less than export levels at the CVP and SWP export facilities in the south Delta, or when Old River near Mossdale is closed with a barrier, flows in Old and Middle rivers north of the facilities are reversed. Reverse flows in Old and Middle rivers may adversely affect juvenile Chinook salmon migrating through the Delta, including Sacramento River winter-run Chinook salmon that have entered the central Delta (USFWS 1992b, 1995).

In December 1999, under low-flow conditions and high export pumping rates, Delta salinity increased when the DCC gates were closed to protect emigrating juvenile Sacramento River winter-run Chinook salmon. This experience and other, similar experiences in recent years have indicated the need for tools to facilitate operating the DCC gates to better balance fisheries, water quality, and water supply objectives. This understanding led CALFED to consider how to preserve both the benefits to fish of closing the DCC gates and the benefits to water quality of diverting Sacramento River water into the interior Delta, particularly during low-flow periods. As a result, proposals are being considered to screen the DCC gates to divert a smaller amount of water than the present capacity of the gates. The understanding also led to provisions in the 1995 water quality control plan and recent BOs for listed Chinook salmon that require closure of the DCC during extended periods of time. Closures were designed to reduce the fraction of salmon diverted to the interior Delta, thus improving overall salmon survival (69 FR 237, December 10, 2004).

The CVP and SWP export facilities in the south Delta adversely affect survival of anadromous fish in the Delta by resulting in direct losses caused by entrainment and in indirect effects related to changes in the magnitude and direction of flow in Delta channels. Increases in upstream storage and diversions over the last 20 years have significantly reduced inflow to the Delta. Reduced inflow, in combination with increased exports from the Delta, has caused an increase in adverse impacts on anadromous and resident species by reducing net flow through the Delta and Delta outflow.

Diversions. Water diversions reduce the survival levels of emigrating juvenile salmonids by causing direct losses at unscreened or inadequately screened diversions and indirect losses associated with reduced streamflows. Fish screening and salvage efforts at major agricultural diversions have met with variable levels of success, and many smaller unscreened or inadequately screened diversions continue to operate. Fish losses at diversions can result from physical injury, impingement, entrainment, or predation. Delayed passage, increased stress, and increased vulnerability to predation also contribute to mortality caused by diversions. Diversion impacts on anadromous fish depend on diversion timing and magnitude, river discharge, life stage, and other factors.

Juvenile winter-run Chinook salmon migrate through the Delta from January through April. Agricultural diversion levels are low during most of this period, and are highest during late spring and summer (DWR 1990). Diversion levels at the CVP and SWP pumps are high during March and April, however, and entrainment losses of winter-run Chinook salmon juveniles may be substantial (DWR 1990). Storm events and increased Sacramento River discharge may move many winter-run juveniles to the Delta between October and January. Increased Delta exports during such times likely increase direct and indirect entrainment losses.

Harvest. Although ocean harvest of Sacramento River winter-run Chinook salmon is not considered a key factor leading to the decline of the population, NMFS does consider ocean harvest to be a significant source of mortality to the population (69 FR 237, December 10, 2004). The harvest rate of winter-run Chinook salmon is lower than the harvest rate calculated for other runs, primarily because winter-run adults migrate from the ocean from December through May, before the main fishing season opens (NMFS 1996). Sacramento River winter-run Chinook salmon adults migrate when they are 2 to 3 years old. Fish that are 2 years old do not reach legal commercial size in the ocean, and most 3-year-old fish reach legal size late in the commercial season. Legal size limits for sportfishing allow the take of 2-year-old fish, and about 70 percent of the ocean catch of Sacramento River winter-run Chinook salmon may be attributable to sportfishing (NMFS 1996).

Ocean-fishing regulations have been implemented that further restrict the sport season and close some areas to fishing, but the effects of these changes on catch of Sacramento River winter-run Chinook salmon are uncertain. DFG and NMFS do not consider fishing mortality a major factor in the decline of the winter-run Chinook salmon population

(DFG 1989). Fishing mortality, however, could delay recovery of the run if other limiting factors were ameliorated.

5.1.4 Central Valley Spring-Run Chinook Salmon

On September 16, 1999, the Central Valley spring-run Chinook salmon ESU was listed as threatened under the Federal ESA by NMFS. This ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries (NMFS 1999). Critical habitat for this species was designated on February 16, 2000 (65 FR 7764). However, on April 30, 2002, a U.S. district court approved a NMFS consent decree withdrawing the critical habitat designation for this and 18 other ESUs of salmon and steelhead. On December 10, 2004, NMFS published a new proposal to designate critical habitat for 7 ESUs of Chinook salmon and steelhead in California, including the Central Valley spring-run Chinook salmon (69 FR 237). The final designation for critical habitat was published on September 2, 2005, and became effective on January 2, 2006. The critical habitat includes roughly 1,272 miles of occupied stream habitat and 427 square miles of estuarine habitat, including the north Delta (the central and south Delta were excluded) and Suisun, San Pablo, and north San Francisco bays (NMFS 2004; 70 FR 170, September 2, 2005). The only area of critical habitat within the Action Area consists of the northern portions of the DCC, Georgiana Slough, and Threemile Slough, which connect the Sacramento and San Joaquin rivers.

NMFS is in the process of preparing a recovery plan for all listed Central Valley salmon, including Central Valley spring-run Chinook salmon. NMFS issued a recovery outline in 2007, which serves as interim guidance until the full recovery plan is released. The outline identifies the factors that have led to the decline of the ESUs and DPSs, describes past conservation efforts, and provides a preliminary list of recommended recovery measures. Some of the measures listed are provided in the species account for Central Valley spring-run Chinook salmon.

Historic and Current Distribution

In the Central Valley, spring-run Chinook salmon historically migrated upstream to the headwaters of the larger tributaries to the Sacramento and San Joaquin rivers, where they held for several months in deep cold pools (Moyle 2002). Historic runs were reported in the McCloud, Pit, Little Sacramento, Feather, Yuba, and American rivers, and in the San Joaquin, Stanislaus, Tuolumne, and Merced rivers (Moyle 2002). Today, Central Valley spring-run Chinook salmon persist in only a few systems within the Sacramento River watershed.

Abundance Trends

Spring-run Chinook salmon in the Central Valley was once among the largest runs on the Pacific Coast (Yoshiyama, Fisher, and Moyle 1998). The Sacramento River drainage alone was estimated to support more than 100,000 spring-run Chinook salmon in many years between the late 1800s and 1940s (Moyle 2002). Before the construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River alone (Fry 1961). Construction of other dams on the American, Mokelumne, Stanislaus, Tuolumne, and Merced rivers extirpated the spring-run from these watersheds. Dam construction and irrigation diversions, which eliminated access to upstream spawning and holding areas, extirpated the spring-run from the San Joaquin River Basin by the late 1940s (Skinner 1962) and greatly reduced spring-run numbers in the Sacramento River Basin. Because of extensive hatchery introductions, most spring-run Chinook currently in the Sacramento River mainstem have hybridized with fall-run fish and are heavily introgressed with fall-run Chinook characteristics, particularly with regard to run timing (Yoshiyama, Fisher, and Moyle 1998). Stocks in Deer, Mill, and Butte creeks appear to have minimal to no hatchery influence.

The abundance of adult Central Valley spring-run Chinook salmon ESU has broadly fluctuated, ranging from 1,403 in 1993 to 25,890 in 1982 (NMFS 2008). Sacramento River tributary populations in Mill, Deer, and Butte creeks are probably the best trend indicators for the spring-run ESU as a whole because these streams contain the primary independent populations within the ESU. Generally, these streams have shown a positive escapement trend since 1991. Escapement numbers are dominated by Butte Creek returns, which have averaged more than 7,000 fish since 1995. During this same period, adult returns have averaged 778 fish on Mill Creek and 1,463 fish on Deer Creek. Although recent trends are positive, annual abundance estimates display a high level of fluctuation, and the overall number of spring-run remains far below estimates of historic abundance.

Life History

Some spring-run Chinook salmon are thought to exhibit a classic “stream-type” life history pattern (Moyle 2002). Stream-type Chinook salmon spend 1 or more years in freshwater before migrating downstream toward the ocean. As a result, stream-type juveniles are more dependent on freshwater streams. Stream-type (yearling) smolts are much larger than their ocean-type (subyearling) counterparts when entering salt water; therefore, they are able to move offshore relatively quickly, making extensive offshore oceanic migrations. This life-history pattern can separate spring-run Chinook salmon from other salmon runs.

Spring-run Chinook salmon historically migrated farther upstream than other Chinook salmon runs, taking advantage of higher elevation habitats that were inaccessible during summer and fall months (as a result of high temperatures and low flows in lower reaches) (Moyle 2002). This geographic separation also helped preserve their genetic integrity (Moyle 2002).

Only the adults and juveniles of Central Valley spring-run Chinook salmon occur in the Action Area, so only these two life stages are discussed below.

Upstream Migration and Holding. Spring-run Chinook salmon begin their upstream migration in late January to early February (DFG 1998). They enter freshwater as sexually immature adult fish, and their holding period can last for several months before individuals are ready to spawn (Moyle 2002, DFG 1998). Spawning occurs during the fall. Like all other runs of Chinook salmon, adult spring-run Chinook salmon cease feeding after entering freshwater, so they need to conserve energy as they over-summer. Deep, cool, and oxygenated pools are important for salmon energy conservation (Berman and Quinn 1991, DWR and Reclamation 2000).

Juvenile and Smolt Emigration. Juvenile spring-run Chinook salmon may rear in streams for 1–15 months. Some authors (Yoshiyama, Fisher, and Moyle 1998; Moyle 2002) suggest that the spring-run may be rearing for a shorter period than in years past as a response to altered flow regimes (caused by dams and diversions) and their restriction to lower elevation sections of streams (again, because of dams). Rearing occurs in natal streams, the mainstem of the Sacramento River, nonnatal streams, and the Delta. Juveniles that remain in their natal streams to rear tend to emigrate as yearlings, and those that rear in nonnatal streams leave as young-of-the-year (YOY).

Outmigrants may spend some time in the Sacramento River or in the estuary and gain additional size before smolting and migrating out to sea. Juveniles that migrate as yearlings move downstream with the onset of the stormy season, beginning in October of the year after spawning and continuing through March (DFG 1998).

Factors Affecting Central Valley Spring-Run Chinook Salmon

The environmental factors most likely to affect the abundance and distribution of the Central Valley spring-run Chinook salmon ESU are discussed below.

Flow. Reservoir operations have altered the natural flow regime of Central Valley streams by changing the frequency, magnitude, and timing of flow. These changes may affect all spring-run Chinook salmon life stages. Changes in the magnitude and timing of reservoir releases can influence the timing of migration by spring-run Chinook salmon. Relatively early attraction of spring-run Chinook salmon into tributaries can be triggered by occasional releases of cold water from reservoirs or the occurrence of naturally high flows early in the fall. Conversely, low flows and higher water temperatures can inhibit or delay migration to spawning areas.

Suitable flows are necessary year round for juvenile rearing. As flow increases, the area preferred by juvenile Chinook salmon shifts from the center of the channel to submerged terrestrial vegetation on the channel edge and the floodplain. Deeper inundation provides more overhead cover and protection from avian and terrestrial predators than shallow water (Everest and Chapman 1972). In broad low-gradient rivers, changes in flows can greatly increase or decrease the lateral area available to juvenile Chinook salmon, particularly in riffles and shallow glides.

The stream reaches that are presently accessible to spring-run Chinook salmon often lack the summer habitat conditions needed to sustain juvenile spring-run through their freshwater rearing period (70 FR 170, September 2, 2005). These conditions can be exacerbated by reservoir operations and water diversions that reduce summer flows, and can be particularly severe in drought years.

Water Temperature. Water temperature is a primary limiting factor for natural production of spring-run Chinook salmon on Central Valley streams (NMFS 1999). Appropriate water temperature regimes below many dams cannot be maintained at levels comparable to what was achieved naturally in the upper watersheds that previously provided habitat.

Altered Pathways for Adult and Juvenile Migration Through the Delta. The most direct route through the Delta for migrating adult and juvenile spring-run Chinook salmon is the Sacramento River channel. Factors affecting straying of spring-run adults and juveniles in the Delta and potential consequences are the same as those described above for winter-run Chinook salmon.

Diversions. Water diversions reduce the survival levels of emigrating juvenile salmonids by causing direct losses at unscreened or inadequately screened diversions and indirect losses associated with reduced streamflows. Fish screening and salvage efforts at major agricultural diversions have met with variable levels of success, and many smaller unscreened or inadequately screened diversions continue to operate. Fish losses at diversions can result from physical injury, impingement, entrainment, or predation. Delayed passage, increased stress, and increased vulnerability to predation also contribute to mortality caused by diversions. Diversion impacts on anadromous fish depend on diversion timing and magnitude, river discharge, life stage, and other factors.

The CVP and SWP export facilities in the south Delta adversely affect survival of anadromous fish in the Delta by resulting in direct losses caused by entrainment and in indirect effects related to changes in the magnitude and direction of flow in Delta channels. Increases in upstream storage and diversions over the last 20 years have significantly reduced inflow to the Delta. Reduced inflow, in combination with increased exports from the Delta, has caused an increase in adverse impacts on anadromous and resident species by reducing net flow through the Delta and Delta outflow. Unscreened Delta diversions have contributed to fish losses.

A portion of the juvenile spring-run Chinook salmon migrating down the Sacramento River may be drawn toward the CVP and SWP pumps. Although both pumping plants have louver-type fish screens that may be 90 percent effective for downstream-migrating spring-run Chinook salmon, high prescreening losses attributed to predation also occur, particularly at the CVP and SWP pumping plants.

5.1.5 Southern Distinct Population Segment of North American Green Sturgeon

North American green sturgeon have been separated into two DPSs: the northern DPS (all populations north of and including the Eel River) and the southern DPS (coastal and Central Valley populations south of the Eel River). On April 15, 2004, NMFS announced that the listing status of the northern and southern DPSs of green sturgeon would change from a candidate species to a species of concern (69 FR 117, June 18, 2004). However, litigation challenged the determination by NMFS that green sturgeon did not warrant listing as an endangered or threatened species under the ESA. The legal challenge asserted that the agency was arbitrary and capricious in failing to examine whether habitat loss constituted a significant portion of the species' range (70 FR 65, April 6, 2005). The court partially agreed with the plaintiff's motion, and remanded the determination to NMFS for further analysis and decision on whether green sturgeon are endangered or threatened in a significant portion of their range. After the review, the southern DPS was listed as threatened under the Federal ESA (71 FR 67, April 7, 2006).

NMFS has not prepared a recovery plan for the southern DPS of North American green sturgeon. However, NMFS did prepare a status review update for green sturgeon that includes a discussion of factors responsible for the decline of green sturgeon and a description of restoration objectives and recovery criteria (http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/greensturgeon_update.pdf).

Historic and Current Distribution

Green sturgeon are found in the lower reaches of large rivers from British Columbia south to the Sacramento River. The southernmost spawning population is in the Sacramento River. Spawning populations existed historically in the Eel and Klamath-Trinity River systems. The Klamath River still maintains a spawning population, but the Eel and Trinity rivers do not. In the Central Valley, spawning habitat may have extended to the Butte Creek watershed. Currently, spawning occurs in the mainstem Sacramento River and some spawning may occasionally take place in the Feather River (Beamesderfer and Webb 2002). Juvenile fish have been collected in the Sacramento River near Hamilton City, and in the Delta and San Francisco Bay. Adults and juveniles have been observed near RBDD in late winter and early spring. Individuals tagged by DFG in the Delta have been recaptured off Santa Cruz, California; in Winchester Bay on the southern Oregon coast; at the mouth of the Columbia River; and in Grays Harbor, Washington (Moyle 2002).

Abundance Trends

Limited information about population abundance for the southern DPS of North American green sturgeon comes from incidental captures by a DFG sturgeon tagging program to monitor white sturgeon (NMFS 2008). By comparing ratios of white-sturgeon to green-sturgeon captures, DFG provides estimates of adult and subadult green sturgeon abundance. Estimated abundance between 1954 and 2001 ranged from 175 fish to more than 8,000, with an average of 1,509 fish per year. However, because of biases and errors, DFG does not consider these estimates reliable.

The only existing information about changes in the abundance of the southern DPS of green sturgeon relates to changes in abundance in green sturgeon salvage at the south Delta export facilities between 1968 and 2006. Before 1986, the average number of southern DPS of green sturgeon salvaged per year at the two export facilities combined was 1,621; from 1986 on, the average per year was fewer than 100 (70 FR 17386–17401, April 5, 2005). In light of the increased exports, particularly during the previous 10 years, it is clear that the abundance of green sturgeon is declining. Recent spawning population estimates using sibling-based genetics indicate spawning populations of 32 spawners in 2002, 64 in 2003, 44 in 2004, 92 in 2005, and 124 in 2006 above RBDD (with an average of 71) (NMFS 2008).

Life History

Green sturgeon are anadromous, migrating from the ocean between March and July to spawn when temperatures in the rivers are between 45 and 57°F. Females produce 60,000–140,000 eggs that are broadcast in swift water and are then fertilized externally. Eggs hatch in about 8 days at 55°F. Juveniles generally migrate downstream in spring or fall between 1 and 3 years of age. During this time they remain close to estuaries, and subsequently migrate long distances as they grow. Males tend to grow more slowly and mature more rapidly than females, and consequently spend only 3to 9 years at sea before returning, whereas females spend 3 to 13 years at sea before returning. Mature fish are typically 15 to 20 years old. Juveniles are known to consume small fish and amphipods, while adults eat fish, shrimp, mollusks, and other large invertebrates.

Factors Affecting Southern Distinct Population of the North American Green Sturgeon

The environmental factors most likely to affect the abundance and distribution of the southern DPS of North American green sturgeon are discussed below.

Flow. Low flow rates likely reduce survival and production of the southern DPS of North American 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 in the Delta, and decreasing nutrient supply to their nurseries (DFG 1992a).

Water Temperatures. High water temperatures, which were once a problem for sturgeon in the Sacramento River, were remedied by installation of the Shasta Dam temperature control device in 1997. Although Shasta Dam has a limited storage capacity, and cold-water reserves could be depleted in long droughts, water temperatures at RBDD have not been higher than 61°F since 1995. Optimal water temperatures for development, growth and survival of green sturgeon egg and larvae are between 59 and 66°F (Mayfield and Cech 2004). Before the installation of the temperature control device, green sturgeon reproduction may have been adversely affected by temperature, potentially affecting the overall population size and age structure.

Water Quality. Contamination of the Sacramento River increased substantially in the mid-1970s when application of rice pesticides increased (USFWS 1996). White sturgeon may also accumulate polychlorinated biphenyls (PCB) and selenium (White et al. 1989). Although green sturgeon spend more time in the marine environment than white sturgeon and may have less exposure, some risk still exists from contaminants. In addition, sediments in the water during the spawning period may reduce the adhesive properties of green sturgeon eggs, which in turn may result in reduced spawning success.

Barriers to Fish Passage. The restriction of spawning to a limited area of the Sacramento River is considered the primary factor for the decline of the southern DPS of green sturgeon. Dams are impassible barriers that block access by green sturgeon to what were likely historic spawning grounds upstream (USFWS 1996). Potential barriers to migration by adult green sturgeon include the Keswick and Oroville dams, RBDD, Sacramento DWSC locks, Fremont Weir, Sutter Bypass, the DCC gates on the Sacramento River, and Shanghai Bench and the Sunset Pumps on the Feather River (70 FR 65, April 6, 2005).

Water Diversions and Exports. The threats of screened and unscreened agricultural water diversions and municipal and industrial diversions in the Sacramento River and Delta to green sturgeon are largely unknown because juvenile sturgeon are often not identified, and because current NMFS and DFG screen criteria do not address sturgeon. The high density of water diversion structures along rearing and migration routes of green sturgeon presents a potential threat; therefore, NMFS has recommended further studies (70 FR 65, April 6, 2005).

Introductions of Nonnative Species.
Several nonnative species that have been introduced into the San Francisco estuary outcompete the native species, causing a replacement in the food sources available to green sturgeon. For example, the Asian clam (*Potamocorbula amurensis*), introduced in 1988, has become the most common food of white sturgeon and was found in the only green sturgeon examined (DFG 2002). This clam is known to bioaccumulate selenium, a toxic metal that could affect the physiology of the green sturgeon (DFG 2002). Green sturgeon juveniles may also experience predation by introduced species, including striped bass.

Sportfishing. Green sturgeon are highly susceptible to mortality from sportfishing. When harvest rates are high, population recovery is slow because of the green sturgeon's slow growth rate, long life span, and age at first spawn. Protective measures have been implemented restricting harvest to sturgeon 46 to 72 inches long. Most sportfishing in the Central Valley is for white sturgeon, but green sturgeon are caught incidentally.

5.2 Essential Fish Habitat

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. EFH is the aquatic habitat (water and substrate) necessary for fish to spawn, breed, feed, or grow to maturity (50 CFR Part 227, March 19, 1988) that will allow a level of production needed to support a long-term, sustainable commercial fishery and contribute to a healthy ecosystem. The following important components of EFH must be adequate for spawning, rearing, and migration:

- Substrate composition
- Water quality
- Water quantity, depth, and velocity
- Channel gradient and stability
- Food
- Cover and habitat complexity
- Space
- Access and passage
- Habitat connectivity

The *Pacific Coast Groundfish Fishery Management Plan* has designated EFH for 83 species of groundfish, which taken together include all waters from the high-water line, and the upriver extent of saltwater intrusion in river mouths along the coast from Washington to California.

All Chinook salmon ESUs (Sacramento River winter-run, Central Valley spring-run, and Central Valley fall-/late fall-run) are included in the Pacific salmon EFH. The geographic ranges of each run overlap with the Action Area. Species descriptions for Sacramento River winter-run and Central Valley spring-run Chinook salmon are provided above, and impacts of WY 2010 Interim Flows on these species are described in Chapter 6 of this BA; therefore, these species and their impacts from WY 2010 Interim Flows are not described further. Descriptions of the effects on starry flounder and fall-/late fall-run Chinook salmon are provided below.

5.2.1 Starry Flounder

The starry flounder (*Platichthys stellatus*) is managed by the *Pacific Coast Groundfish Fishery Management Plan* of the Pacific Fishery Management Council. “Composite habitats” most important for the starry flounder are estuarine habitats (for all life stages), nonrocky shelf habitats (for juveniles and adults), and shallow coastal habitats (for eggs and larvae), as defined by the fishery management plan (Reclamation 2008). The starry flounder “Composite Estuarine EFH” overlaps the Action Area for WY 2010 Interim Flows. Therefore, the species is subject to EFH consultation (PFMC 1998).

Before the late 1980s, the starry flounder was common in both the commercial and recreational fisheries of northern and central California (DFG 2001). Historically, most of the commercial catch was made by bottom trawl, but during the 1980s, many starry flounders were also taken by gill and trammel nets in central California. During the late 1980s, commercial landings declined sharply and remained at relatively low levels through the 1990s. From 1992 through 1999, landings averaged only 62,225 pounds, ranging from a low of 25,353 pounds in 1995 to a high of 100,309 pounds in 1999. This is in contrast to annual landings of more than a million pounds during the 1970s and half a million pounds in the 1980s. The recreational catch of starry flounders is from piers, boats, and shore, usually in estuarine and adjacent coastal waters. The estimated annual recreational catch for this species in California from 1981 to 1989 averaged 40,000 fish. The recreational catches, like commercial landings, declined dramatically during the 1990s. Catch estimates from 1993 through 1999 averaged 6,000 fish per year, and ranged from a high in 1998 of 15,000 fish to lows in 1994 and 1996 of 3,000 fish.

Starry flounders range from Korea and Japan north to the Bering and Chukchi seas and the coast of Alaska to southern California, although they are uncommon south of Point Conception. The starry flounder is primarily a coastal species, living on sand and mud bottoms and avoiding rocky areas. Though found to depths of 900 feet, this species is much more common in shallower waters. Starry flounders are frequently found in bays and estuaries and are tolerant of brackish and fresh water. Tagging studies have not demonstrated extensive migrations, although there is some movement along the shore. Seasonal inshore-offshore movements of these fish possibly related to spawning are assumed to occur.

Starry flounder can be found in Suisun Bay and the lower portion of the San Joaquin River in the Delta. The distribution of the starry flounder tends to shift with growth. Young juveniles are commonly found in fresh or brackish water of Suisun Bay, Suisun Marsh, and the Delta; older juveniles range from brackish to marine water of Suisun and

San Pablo bays; and adults tend to live in shallow marine waters within and outside San Francisco Bay before returning to estuaries to spawn (Reclamation 2008).

Life History

Most spawning by the starry flounder occurs in shallow waters near the mouths of rivers and estuaries during the winter. In central California, December and January are the peak months of spawning. Metamorphosis from larvae to juvenile occurs 39–75 days after hatching. Females grow faster and reach larger sizes than do males. In central California, most males are sexually mature at 2 years and an average 14.5 inches, and most females mature at 3 years and 16 inches. The maximum size reported is 36 inches.

Starry flounder larvae feed on planktonic organisms, while young juveniles feed primarily on copepods and amphipods. As they grow, their diet changes. Five-inch fish have developed jaws and teeth that allow them to crush small clams and pull worms from their burrows. Sand dollars, brittle stars, and fish are included in the diets of larger starry flounders. Historically, in San Francisco Bay, small starry flounder fed mainly on opossum shrimp until the invasion of the overbite clam (*Potamocorbula amurensis*) caused a major reduction in shrimp abundance, forcing starry flounders to switch to a more diverse diet (Reclamation 2008). Wading and diving seabirds such as herons and cormorants, as well as marine mammals such as harbor seals, feed on juvenile starry flounders in estuaries. On occasion, a fish is caught that displays physical characteristics intermediate between a starry flounder and an English sole and may be a hybrid of those species.

Habitat Requirements

Although the starry flounder is considered a euryhaline fish, a USFWS study using fyke nets to capture salmon and striped bass took starry founder in freshwater portions of the Delta. Eighty starry flounder were taken in the San Joaquin River one-half mile downstream from the Antioch Bridge (Reclamation 2008). Salinity at this location during the April–September period of the study varied from about 0.06 to 9.0 ppt, a variation from freshwater to brackish water with salinity about one-quarter that of the ocean. One hundred ninety-three starry flounder were captured in the Sacramento River at Rio Vista, where the salinity varied from 0.02 to 0.5 ppt.

Starry flounder generally prefer tidal, low-gradient areas that have sandy or muddy bottoms (Reclamation 2008). Most found in fresh water are YOY. Abundances may be lower during dry years, but young are more likely to be found farther upstream, where they are vulnerable to entrainment by the pumps in the south Delta (Moyle 2002). The smallest fish are generally found farthest upstream, and seek areas with higher salinity as they grow (Reclamation 2008). Thus, from April to June, most YOY are living in salinities of less than 2 ppt, but by July and August they have shifted to salinities of 10 to 15 ppt. Water temperatures may also influence distribution because starry flounder are usually found at 50 to 68°F. Starry flounders less than about 8 inches in length encountered in freshwater are likely mostly migrants from salt water, rather than fish that have reared there (Moyle 2002).

In the San Francisco estuary, some smaller flounders may have originated from spawning within the estuary, but most are apparently carried into San Francisco Bay from nearshore ocean waters by strong tidal currents along the bottom (Reclamation 2008). These currents are strongest during years of high outflow from the rivers; consequently, juvenile starry flounder tend to be most abundant in the estuary during wet years (Moyle 2002). Higher abundances may be related to the greater extent of low-salinity rearing areas and the greater abundance of food organisms preferred by small flounder. Summertime abundance of YOY starry flounder in San Francisco Bay is closely related to discharge into the bay during the previous winter (Reclamation 2008).

Population Decline

No studies have been conducted to determine the population size of the starry flounder, but commercial landing and recreational catch trends suggest that the California population is now at extremely low levels. Reasons for the decline are uncertain, but fishing pressure is likely a factor. Moyle (2002) suggests that the decline may be related to changing estuarine conditions or to changes in fishing regulations that reduce catch. SWP/CVP fish salvage facilities in the Delta recorded average monthly salvage records for the starry flounder for the period from 1981 to 2002 as 187 fish per month at the CVP pumps and 77 at the SWP pumps (Reclamation 2008). The large population decline suggested by fishery trends is substantiated by a fishery-independent trawl survey conducted by DFG in the San Francisco estuary from 1980 through 1995. Results of this survey show abundance of age-0 and age-1+ starry flounder dropping dramatically during the late 1980s and remained at low levels through the 1990s (DFG 2001). Recruitment is determined largely by survival of larval and juvenile fish. Given the importance of bays and estuaries to the young of this species, the continued environmental health of these areas may be the most important factor in maintaining healthy populations of starry flounder.

5.2.2 Chinook Salmon

All four runs of Chinook salmon are included under the protection of EFH. However, effects on spring-run and winter-run resulting from the WY 2010 Interim Flows are discussed in Chapter 6 of this BA, and so are not described here.

Central Valley fall-run and late-fall-run Chinook salmon are considered by NMFS to be the same ESU (64 FR 50394–50415, September 16, 1999). Fall-run Chinook salmon is currently the most abundant and widespread salmon run in California (Mills et al. 1997). NMFS (1999) determined that listing this ESU as threatened was not warranted (64 FR 50394–50415, September 16, 1999), but subsequently classified it as a species of concern because of specific risk factors (69 FR 19975, April 15, 2004).

Fall-run Chinook salmon is currently the most abundant race of salmon in California (Mills et al. 1997). In the San Joaquin River Basin, fall-run Chinook salmon historically spawned in the mainstem San Joaquin River upstream from the Merced River confluence and in the mainstem channels of the major tributaries. Dam construction and water diversion dewatered much of the mainstem San Joaquin River, limiting fall-run Chinook salmon to the three major tributaries, where they currently spawn and rear downstream from mainstem dams.

Estimates of fall-run Chinook salmon are available from 1940, but systematic counts of salmon in the San Joaquin Basin began in 1953, long after construction of large dams on the basin's major rivers. Comparable estimates of population size before 1940 are not available. Since population estimates began, the number of fall-run Chinook salmon returning to the San Joaquin Basin annually has fluctuated widely. Most recently, escapement in the Tuolumne River dropped from a high of 40,300 in 1985 to a low of about 100 as a result of the 1987 through 1992 dry period (EA 1997). With increased precipitation and improved flow conditions, escapement increased to 3,300 in 1996 (EA 1997). Since 1991, hatchery production is estimated to compose about 30–60 percent of the fall-run Chinook run in the San Joaquin Basin (Yoshiyama, Fisher, and Moyle 1998).

Production of fall-run Chinook salmon in the three tributaries is believed to be limited by habitat conditions for rearing juveniles and outmigrating smolts (SJRRP 2007a). Population analyses conducted for fall-run Chinook salmon in the Stanislaus and Tuolumne rivers indicate that the quality of the juvenile rearing and migratory habitats controls the production of adult salmon in these rivers. Moreover, the analyses show that the most important environmental factor that affects the survival of the juveniles and smolts is streamflow during the late winter and spring. Since the 1940s, production of fall-run Chinook salmon in the two rivers has been highest during wet years, characterized by high flows from February through June, when juvenile salmon rear and migrate.

Life History

Except for timing, the life-history characteristics and habitat requirements for fall-/late fall-run Chinook salmon are similar to those for both spring- and winter-run Chinook salmon. The differences are described below.

Migration by fall-run adults to spawning habitat, and thus through the Delta, is typically initiated around June and continues through December, but peaks in October and November. Spawning takes place primarily between October and December. Late fall-run Chinook salmon adults migrate upstream between late October and April, and spawn from January through April.

Fall-run salmon fry disperse downstream from early January through mid-March, whereas the smolts primarily migrate between late March and mid-June in the Stanislaus River (SJRRP 2007b). Late fall-run, however, begin outmigration between after rearing in freshwater for 7 to 13 months.

Fall-run smolts enter the San Francisco estuary primarily in May and June (MacFarlane and Norton 2002), where they spend days to months completing the smoltification process in preparation for ocean entry and feeding (Independent Scientific Group 1996). Within the estuarine habitat, movements by juvenile Chinook salmon are dictated by the tidal cycles, following the rising tide into shallow-water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levy and Northcote 1981, Healey 1991).

Juvenile Chinook salmon spent an average of about 40 days migrating through the Delta to the mouth of San Francisco Bay in spring 1997, but grew little in length or weight until they reached the Gulf of the Farallon Islands (MacFarlane and Norton 2002).

Based on the mainly ocean-type life history observed (i.e., fall-run Chinook salmon), MacFarlane and Norton (2002) concluded that unlike other salmonid populations in the Pacific Northwest, Central Valley Chinook salmon show relatively little estuarine dependence and may benefit from expedited ocean entry. It is possible that the absence of extensive marsh habitats outside of Suisun and San Pablo bays and the introduction of exotic species of zooplankton limit important food resources in the San Francisco estuary that are present in other Pacific Northwest estuaries (MacFarlane and Norton 2002).

When fall-run Chinook salmon produced from the Sacramento–San Joaquin system enter the ocean, they appear to head north and rear off the Northern California/southern Oregon coast (Cramer 1987). Fall-run Chinook typically rear in coastal waters early in their ocean life. Ocean conditions are likely an important cause of density-independent mortality and interannual fluctuations in escapement sizes. Central Valley Chinook salmon typically spend 2 to 4 years at sea (Mesick and Marston 2007). Most mortality experienced by salmonids during the marine phase occurs soon after ocean entry (Pearcy 1992, Mantua et al. 1997).

5.3 Terrestrial Species

5.3.1 Plants

Known occurrences of federally listed plant species near the Restoration Area are shown in Exhibits 2a–2c (CNDDB 2009).

Succulent Owl's-Clover

Succulent owl's-clover (*Castilleja campestris* ssp. *succulenta*), which is Federally listed as threatened, occurs in vernal pool habitat, often in acidic conditions. It is discontinuously distributed through the southern Sierra Nevada foothills and eastern San Joaquin Valley in Fresno, Madera, Merced, Mariposa, San Joaquin, and Stanislaus counties at elevations of 160 to 2,500 feet above mean sea level. It has been documented in the vicinity of, but not within, the Restoration Area, with two occurrences documented just outside of the Restoration Area boundary in Reach 1 (CNDDB 2009). One of these occurrences was last observed in 1938 and may be extirpated because the site had been disked and the species was absent when a visit to relocate the occurrence was made in 1981. Critical habitat for succulent owl's-clover is designated in and immediately adjacent to the Restoration Area in Reach 1A (Figure 5-1). Urbanization, agriculture, and flood control are the primary threats to this species (CNPS 2009). Grazing and trampling are frequently suggested as threats, but some level of grazing may benefit this species by controlling nonnative competitors. Succulent owl's-clover is covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). This recovery plan addresses a large number of vernal pool–associated species through an ecosystem approach to recovery that is focused on habitat protection and management. This species has been or is proposed to be covered by several regional HCPs.

Hoover's Spurge

Hoover's spurge (*Chamaesyce hooveri*), which is Federally listed as threatened, is discontinuously distributed in the Central Valley in Tehama, Glenn, Butte, Colusa Stanislaus, Merced, and Tulare counties. Its elevation range is 80–820 feet above mean sea level. Hoover's spurge, a small, prostrate annual herb species, is found in relatively large, deep vernal pools among the rolling hills, remnant alluvial fans, and depositional stream terraces of the eastern Sacramento and San Joaquin valleys (Stone et al. 1988 cited in USFWS 2005). It has been documented in the vicinity of, but not in, the Restoration Area. Critical habitat for Hoover's spurge is designated in and immediately adjacent to the Restoration Area in Reaches 4B1 and 4B2 (Figure 5-1). Conversion of habitat to agricultural land uses, competition from nonnative species, and grazing are recognized as threats to Hoover's spurge (CNPS 2009), although some level of grazing may benefit this species by controlling nonnative competitors. Hoover's spurge is covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). This recovery plan addresses a large number of vernal pool–associated species through an ecosystem approach to recovery that is focused on habitat protection and management. This species has been or is proposed to be covered by several regional HCPs.

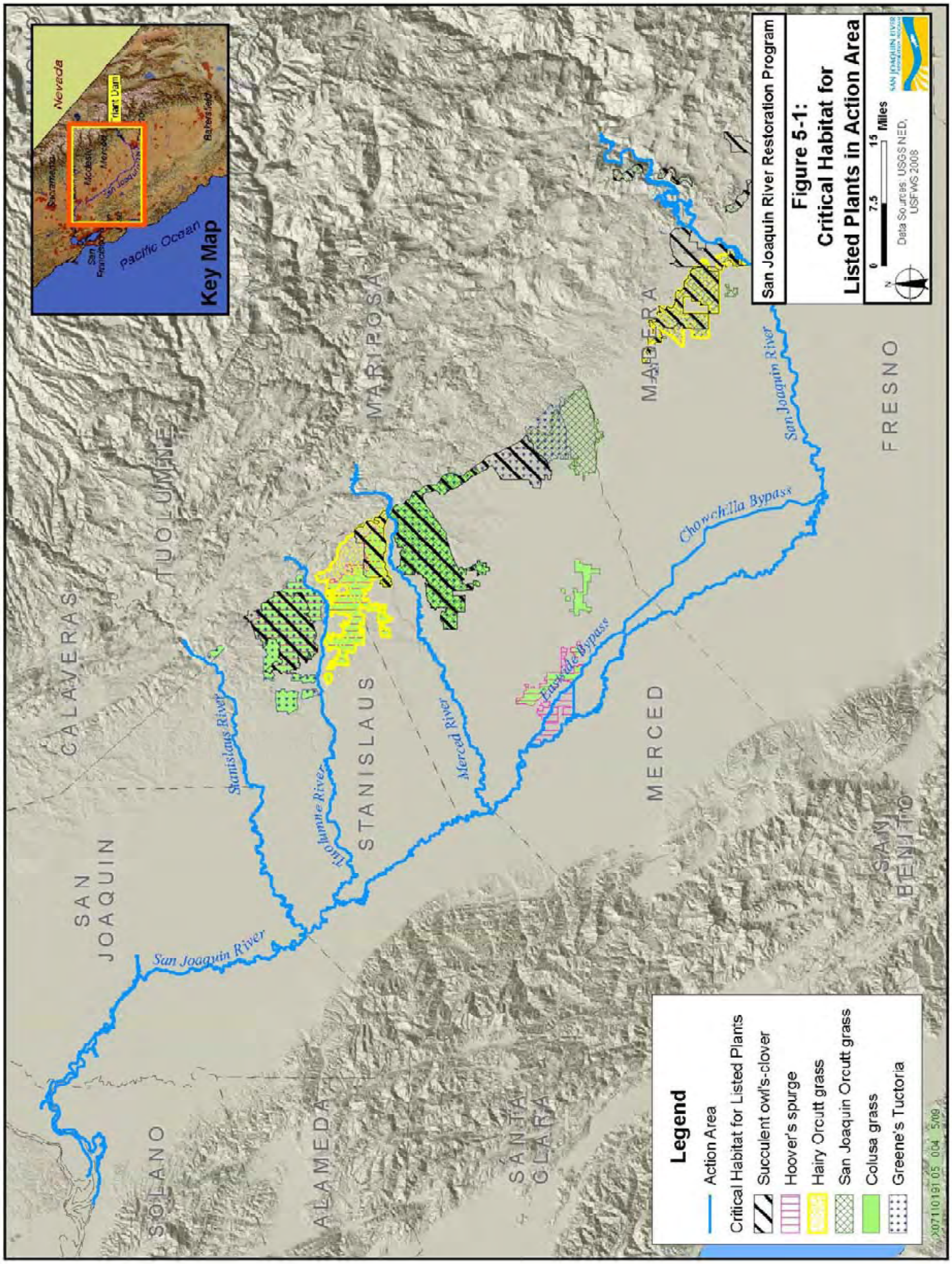


Figure 5-1.
Critical Habitat for Listed Plants in Action Area

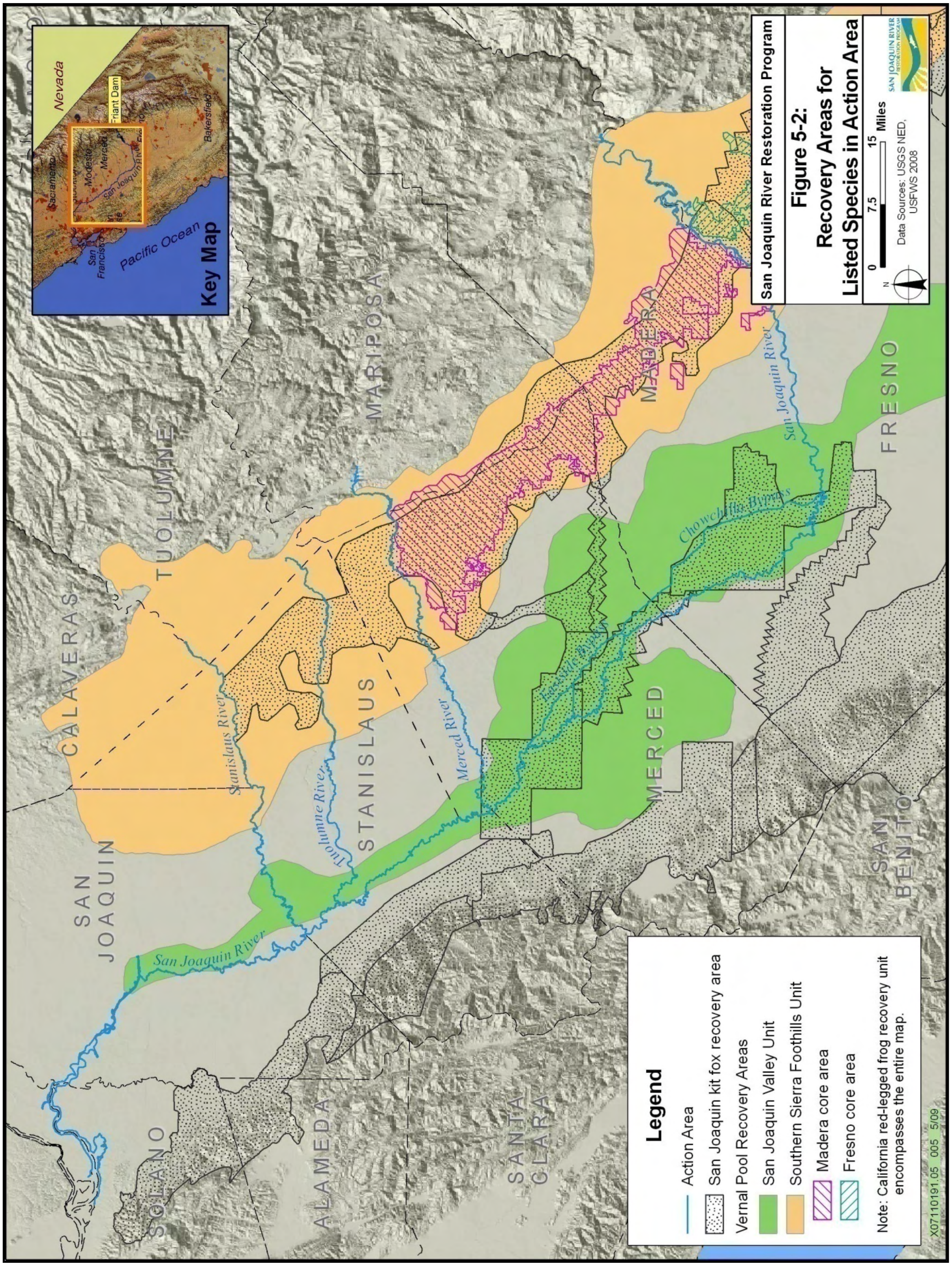


Figure 5-2.
Recovery Areas for Listed Species in Action Area

Palmate-Bracted Bird's-Beak

Palmate-bracted bird's-beak is Federally listed as endangered, with only seven known populations: four in the Sacramento Valley, one in the Livermore Valley, and two in the San Joaquin Valley. The elevation range of this species is 15 to 500 feet above mean sea level. Palmate-bracted bird's-beak grows in alkaline soils in chenopod scrub and valley and foothill grassland habitat, primarily at the edges of channels, with individuals scattered in seasonally wet depressions, alkali scalds, and grassy areas (USFWS 1998a, cited in McBain and Trush 2002). It has been documented in the vicinity of, but not in, the Restoration Area, including at the Alkali Sink Ecological Area and Mendota NWR, approximately 4 miles south of Reach 2A, and between the San Joaquin River and the Chowchilla Bypass near Reach 3. This plant species is threatened by agricultural conversion, urbanization, industrial development, off-road vehicles, modified hydrology, and grazing. This species is covered by the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a) and recovery units include portions of the Action Area (Figure 5-2). The recovery strategy for this species is focused on maintaining self-sustaining populations in preserved areas, protecting existing populations on private land, surveying historical occurrences, and reintroducing the species in areas where it has been extirpated.

Colusa Grass

Colusa grass (*Neostapfia colusana*), which is Federally listed as threatened, is known from approximately 40 populations in Merced, Stanislaus, Solano, and Yolo counties, including occurrences in and near the Arena Plains Unit of the San Luis NWR Complex. It has been found in northern claypan and northern hardpan pool types at elevations ranging from 15 to 4,000 feet above mean sea level. It grows in large or deep vernal pools that retain water until late spring (Stone et al. 1988 cited in USFWS 2005); these pools usually have adobe clay soils. It has been documented in the vicinity of, but not in, the Restoration Area. Critical habitat is designated for this species and is located in and adjacent to Reaches 4B1 and 4B2 (Figure 5-1). The biggest threat to survival of Colusa grass is conversion of habitat to agricultural land uses. Development, flood control, overgrazing, and competition from nonnative species are also recognized threats. Other observed threats at specific sites include poultry manure, herbicides, and groundwater contamination by industrial chemicals (USFWS 2005). Colusa grass is covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). This recovery plan addresses a large number of vernal pool–associated species through an ecosystem approach to recovery that is focused on habitat protection and management. This species has been or is proposed to be covered by several regional HCPs.

San Joaquin Valley Orcutt Grass

San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*), which is Federally listed as endangered, is restricted to the vernal pool region of the eastern San Joaquin Valley, from Stanislaus County to Tulare County, at elevations up to 2,500 feet. San Joaquin Valley Orcutt grass, a small, grayish green, tufted annual of the grass family, is found on alluvial fans, stream terraces, and tabletop lava flows in northern claypan, northern hardpan, and northern basalt flow vernal pools. The species grows primarily in large pools that retain water until late spring (Stone et al. 1988 cited in USFWS 2005). Most of the extant occurrences are concentrated in two small areas of eastern Merced County: an occurrence that overlaps with the Restoration Area in Reach 1A and another that is just outside the Restoration Area boundary on the east side of Friant Road. Survival of San Joaquin Valley Orcutt grass is seriously threatened by agricultural conversion, urbanization, overgrazing, channelization and other hydrological modifications, and competition from nonnative plants (CNPS 2009, USFWS 2005). Grasshopper herbivory during large outbreaks threatens some populations. Critical habitat for this species is designated immediately adjacent to Reach 1A (Figure 5-1). San Joaquin Valley Orcutt grass is covered by the *Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). This recovery plan addresses a large number of vernal pool–associated species through an ecosystem approach to recovery that is focused on habitat protection and management. This species has been or is proposed to be covered by several regional HCPs.

Hairy Orcutt Grass

Hairy Orcutt grass (*Orcuttia pilosa*), which is Federally listed as endangered, has a discontinuous distribution through the Central Valley and southern Sierra Nevada foothills, with populations in the north in Tehama, Glenn, and Butte counties and southern populations in Madera, Merced, and Stanislaus counties. Its elevation range is 175–650 feet above mean sea level. This species is found in vernal pools in undulating topography on remnant alluvial fans and stream terraces. The species grows primarily in large pools that retain water until late spring (Stone et al. 1988 cited in USFWS 2005). It has been documented in the vicinity of the Restoration Area in the Gregg, Herndon, Lanes Bridge, and Madera quadrangles. There are no known occurrences in the Restoration Area; the nearest documented occurrence (CNDDB Occurrence 28) is located approximately 3,000 feet outside the Reach 1A boundary. Critical habitat for this species is designated in and immediately adjacent to Reach 1A (Figure 5-1). The biggest threats to the survival of hairy Orcutt grass are habitat conversion to agricultural uses and development (CNPS 2009). Cattle grazing and competition from nonnative species are additional recognized threats. Some populations are vulnerable to extinction from random catastrophic events (e.g., fire, flood, insect infestations) because of their small sizes. Hairy Orcutt grass is covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). This recovery plan addresses a large number of vernal pool–associated species through an ecosystem approach to recovery that is focused on habitat protection and management. This species has been or is proposed to be covered by several regional HCPs.

Greene’s Tuctoria

Greene’s tuctoria (*Tuctoria greenei*), which is Federally listed as endangered, is discontinuously distributed throughout the Central Valley and Sierra Nevada foothills, with populations in Shasta, Tehama, Butte, Glenn, and Merced counties. Historically, this species also was found in San Joaquin, Stanislaus, Madera, and Tulare counties, but known occurrences in these counties are believed to be extirpated (USFWS 2005). There is a single population of this species in Shasta County at an elevation of 3,500 feet, but the remaining current and historically known occurrences range in elevation from 110 to 440 feet above mean sea level. This species is found in northern hardpan, northern claypan, and northern basalt flow vernal pools of intermediate size and typically is found in shallower pools than other species in the Orcuttiaea tribe (i.e., grasses in the Orcutt tribe, which also includes the Orcutt grasses and Colusa grass) or grows at the shallow edges of deeper pools (USFWS 2005). Greene's tuctoria has not been documented in the Action Area, but it was historically known from vernal pool habitat near the Stanislaus and Tuolumne rivers, and critical habitat for this species has been designated in the Action Area along these rivers (Figure 5-1). As with other vernal pool plant species, the biggest threat to Greene's tuctoria is loss of habitat related to agricultural and urban land use conversion. Grasshopper infestations also may pose a threat to this species (USFWS 2005). Observers have documented entire populations of Greene's tuctoria being eaten by grasshoppers before they were able to produce seed (Griggs 1980, cited in USFWS 2005; Griggs and Jain 1983, cited in USFWS 2005; Stone et al. 1988, cited in USFWS 2005). Greene's tuctoria is covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). This recovery plan addresses a large number of vernal pool–associated species through an ecosystem approach to recovery that is focused on habitat protection and management. This species has been or is proposed to be covered by several regional HCPs.

5.3.2 Wildlife

Known occurrences of federally listed wildlife species near the Restoration Area are shown in Exhibits 3a-c (CNDDB 2009).

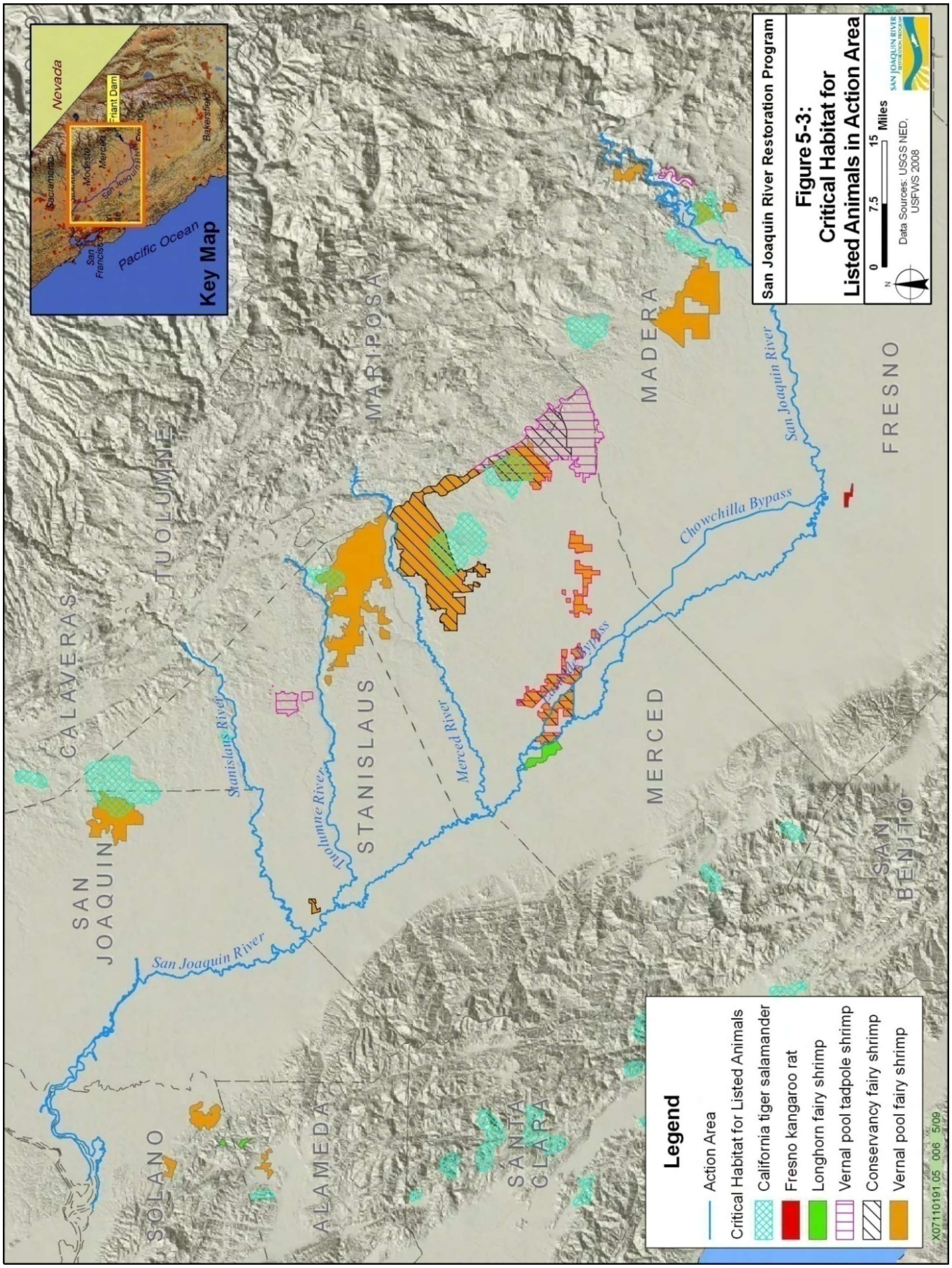


Figure 5-3.
Critical Habitat for Listed Animals in Action Area

Conservancy Fairy Shrimp

Conservancy fairy shrimp (*Branchinecta conservation*) is Federally listed as endangered. Its range extends from the northern Sacramento Valley to the San Joaquin Valley. Conservancy fairy shrimp occurs in vernal pools, swales, and lakes (Helm 1998) that are relatively large (more than several acres in size) and turbid (Eriksen and Belk 1999, Helm 1998, King 1996). It is known to occur in suitable habitat in the San Luis NWR Complex in Reaches 4B2 and 5 and the Eastside Bypass. Designated critical habitat for this species is in and adjacent to the Chowchilla Bypass, the Eastside Bypass, the Mariposa Bypass, and Reaches 4B2 and 5 (Figure 5-3). Vernal pool and seasonal wetlands suitable for this species are not likely to be present in the San Joaquin River corridor (e.g., between the existing banks or levees) of the Restoration Area. The presence of suitable vernal pool or seasonal wetland habitat in the Chowchilla, Eastside, and Mariposa bypasses is unknown. Although these bypasses were created in uplands that historically contained northern claypan vernal pools, land conversion for agricultural development and the subsequent hydrologic modification related to creating the bypasses and agricultural diversions and discharge have eliminated natural vernal pools from many areas. However, because of the high clay content of soils in the area, depressions caused by previous construction activities in upland habitats still tend to hold rainwater for an extended period, so soil and hydrologic conditions may be suitable to support vernal pool invertebrates in some areas. As suggested by a reconnaissance-level survey of the Eastside Bypass conducted in February and March 2000 (DFG 2000), existing conditions in these low-flow channel bypasses are unlikely to be suitable for vernal pool invertebrates because the channel is regularly inundated during seasonal flood flows.

The Conservancy fairy shrimp is threatened primarily by the habitat loss and fragmentation resulting from expansion of agricultural and developed land uses. Vernal pool habitat also can be lost or degraded by other activities that damage or puncture the hardpan (i.e., water-restrictive layer underlying the pool) or by activities that destroy or degrade uplands that contribute water to vernal pools. In addition to habitat conversion, activities causing such loss or degradation include deep ripping of soils; water diversion or impoundment; and application of pesticides, fertilizers, or livestock wastes. Additional threats are incompatible grazing practices, replacement of native plants by nonnatives, and introduction of fish to vernal pools (Robins and Vollmar 2002, Marty 2005, Pyke and Marty 2005, USFWS 2005). The Conservancy fairy shrimp is covered by the *Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). This recovery plan addresses a large number of vernal pool–associated species through an ecosystem approach to recovery that is focused on habitat protection and management. This species has been or is proposed to be covered by several regional HCPs.

Longhorn Fairy Shrimp

Longhorn fairy shrimp (*Branchinecta longiantenna*) is Federally listed as endangered. Its known distribution extends from Contra Costa and Alameda counties to San Luis Obispo County and also includes Merced County (USFWS 2005, CNDDB 2009). Within this geographic range, it is extremely rare in vernal pools and swales. This species is known to occur in suitable habitat in the San Luis NWR Complex in Reach 5. Designated critical habitat for this species is in and adjacent to Reaches 4B2 and 5 (Figure 5-3). Similar to the Conservancy fairy shrimp, vernal pool and seasonal wetlands suitable for this species are not likely to be present in the San Joaquin River corridor (e.g., between the existing banks or levees) of the Restoration Area or in the Chowchilla, Eastside, and Mariposa bypasses.

The longhorn fairy shrimp has likely experienced habitat loss and fragmentation as a result of the expansion of agricultural and developed land uses. However, it is now threatened by habitat loss and disturbance resulting from several site-specific activities at the few locations from which it is known: wind energy development, a water storage project, construction of a dirt access road, and land management activities (USFWS 2005). Additional threats to longhorn fairy shrimp may include incompatible grazing practices and replacement of native plants by nonnatives (Robins and Vollmar 2002, Marty 2005, Pyke and Marty 2005). Similar to the Conservancy fairy shrimp, the longhorn fairy shrimp is covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). In addition, much of the species' known occupied habitat has been partially or fully protected on land managed by the East Bay Regional Park District, USFWS, and the Carrizo Plain National Monument.

Vernal Pool Fairy Shrimp

Vernal pool fairy shrimp (*Branchinecta lynchi*), which is Federally listed as threatened, is found throughout the Central Valley and west to the central Coast Ranges, at sites 30 to 4,000 feet in elevation (USFWS 2005). The species has also been reported from the Agate Desert region of Oregon near Medford, and disjunct populations occur in San Luis Obispo, Santa Barbara, and Riverside counties. Within this geographic range, the vernal pool fairy shrimp inhabits primarily vernal pools (Eng, Belk, and Eriksen 1990). It also occurs in other wetlands that provide habitat similar to vernal pools: alkaline rain-pools, ephemeral drainages, rock outcrop pools, ditches, stream oxbows, stock ponds, vernal swales, and some seasonal wetlands (Helm 1998). Occupied wetland habitats range in size from several square feet to more than 10 acres. This species is not found in riverine or other permanent waters. The vernal pool fairy shrimp is known to occur in suitable habitat in the San Luis NWR Complex in Reaches 4B1, 4B2, and 5 and in the Chowchilla and Eastside bypasses. Critical habitat for this species is near Reach 1A and adjacent to the Chowchilla Bypass, the Eastside Bypass, the Mariposa Bypass, and Reaches 4B2 and 5 (Figure 5-3). Similar to the Conservancy fairy shrimp, vernal pool and seasonal wetlands suitable for this species are not likely to be present in the San Joaquin River corridor (e.g., between the existing banks or levees) Restoration Area or in the Chowchilla, Eastside, and Mariposa bypasses. The threats to the survival of the vernal pool fairy shrimp are similar to those of the Conservancy fairy shrimp, described above. Similarly, the vernal pool fairy shrimp is covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). The vernal pool fairy shrimp has been or is proposed to be covered by several regional HCPs.

Vernal Pool Tadpole Shrimp

The vernal pool tadpole shrimp (*Lepidurus packardi*), which is Federally listed as endangered, is endemic to the Central Valley, with most populations in the Sacramento

Valley. This species has also been reported from the Delta to the east side of San Francisco Bay, and from scattered localities in the San Joaquin Valley from San Joaquin County to Madera County (Rogers 2001). Within this geographic range, vernal pool tadpole shrimp occurs in a wide variety of seasonal habitats: vernal pools, ponded clay flats, alkaline pools, ephemeral stock tanks, and roadside ditches (CNDDB 2009, Helm 1998, Rogers 2001). Habitats where vernal pool tadpole shrimp have been observed range in size from small, clear, vegetated vernal pools to highly turbid pools to large winter lakes (Helm 1998, Rogers 2001). This species has not been reported in pools that contain high concentrations of sodium salts but may occur in pools with high concentrations of calcium salts. Vernal pool tadpole shrimp is known to occur in suitable habitat in the San Luis NWR Complex and at the Great Valley Grasslands State Park in Reaches 4B1, 4B2, and 5 and the Chowchilla and Eastside Bypasses. Critical habitat for this species is in and adjacent to the Chowchilla Bypass, the Eastside Bypass, the Mariposa Bypass, and Reaches 4B2 and 5 (Figure 5-3). Similar to the Conservancy fairy shrimp, vernal pool and seasonal wetlands suitable for this species are not likely to be present in the San Joaquin River corridor (e.g., between the existing banks or levees) of the Restoration Area or in the Chowchilla, Eastside, and Mariposa bypasses. The threats to the survival of the vernal pool tadpole shrimp are similar to those of the Conservancy fairy shrimp, described above. Similarly, the vernal pool tadpole shrimp is covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and recovery units include portions of the Action Area (Figure 5-2). This species has been or is proposed to be covered by several regional HCPs.

Valley Elderberry Longhorn Beetle

Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) is Federally listed as threatened; however, in 2006, USFWS recommended that this species be delisted (USFWS 2006d). This beetle is endemic to the Central Valley. It is found only in association with its host plants, the elderberry shrub (*Sambucus* spp.). In the Central Valley, the elderberry shrub is found primarily in riparian vegetation. The valley elderberry longhorn beetle is known to occur in elderberry shrubs present in the riparian woodland in Reaches 1A and 2. The species is also expected to occur in suitable habitat in other locations in the Restoration Area. Elderberry shrubs are associated with riparian habitats and typically are located on the higher portions of levees and streambanks, which are not subject to inundation or scouring, although some elderberry shrubs in the Action Area were noted to be growing along the channel (ESRP 2004, 2006). This species has experienced substantial loss of riparian habitat containing its host plant, and damage and loss of host plants in remaining habitat. However, its greatest current threat may be predation and displacement by the invasive Argentine ant (*Linepithema humile*) (Huxel 2000). A recovery plan was prepared for this species during the 1980s (USFWS 1984), and regularly implemented conservation measures have included avoidance and minimization of effects on occupied habitat, elderberry transplantation and replacement plantings, and habitat preservation. In part as a result of these measures, extensive areas of habitat have been preserved (USFWS 2006d). As noted above, the species has been recommended for delisting.

California Tiger Salamander

California tiger salamander (*Ambystoma californiense*) is Federally listed as threatened throughout its range except in Sonoma and Santa Barbara counties, where it is listed as endangered (69 FR 47212–47248, 70 FR 49379–49458). The Proposed Action is located within the range of the central population of California tiger salamander (70 FR 49379–49458). The species, endemic to California, ranges across the Central Valley and the eastern foothills of the Sierra Nevada from Yolo County (possibly up to Colusa County) south to Kern County, and coastal grasslands from Sonoma County to Santa Barbara County at elevations ranging from approximately 10 to 3,500 feet above mean sea level (Shaffer and Fisher 1991). The California tiger salamander requires vernal pools, ponds (natural or human made), or semipermanent calm waters (where ponded water is present for a minimum of 3–4 months) for breeding and larval maturation. It also requires adjacent upland areas that contain small-mammal burrows or other suitable refugia for aestivation. Surveys have detected the presence of this species at the West Bear Creek Unit of the San Luis NWR Complex and at Great Valley Grasslands State Park (McBain and Trush 2002). Critical habitat for this species is in and adjacent to Reach 1A (Figure 5-3).

The alteration of either breeding ponds or upland habitat through the introduction of exotic predators (e.g., bullfrogs [*Rana catesbeiana*] and mosquitofish [*Gambusia affinis*]) or the construction of barriers that fragment habitat and reduce connectivity (e.g., roads, berms, and certain types of fences) can be detrimental to the survival of the California tiger salamander (Jennings and Hayes 1994; Trenham, Koenig, and Shaffer 2001). Other threats include vehicular-related mortality, especially during breeding migrations (Barry and Shaffer 1994), and rodent-control programs, which lead to loss of aestivation habitats (Loredo, Van Vuren, and Morrison 1996). A recovery plan for California tiger salamander has not been prepared, and this species is not covered by the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005). However, the recovery plan addresses a large number of vernal pool-associated species through an ecosystem approach focused on habitat protection and management. Thus, the California tiger salamander likely will benefit from many of these recovery actions.

Blunt-Nosed Leopard Lizard

Blunt-nosed leopard lizard (*Gambelia sila*), which is Federally listed as endangered, was historically found throughout the San Joaquin Valley and adjacent foothills, from San Joaquin County to eastern San Luis Obispo County. It currently occupies isolated and scattered areas of undeveloped habitat on the San Joaquin Valley floor and in the eastern foothills of the Coast Ranges. Blunt-nosed leopard lizards are found in areas with sandy soils and scattered vegetation and usually are absent from thickly vegetated habitats (DFG 1992b). On the floor of the San Joaquin Valley, they usually are found in nonnative grassland, valley sink scrub habitats, valley needlegrass grassland, alkali playa, and valley saltbush scrub (USFWS 1998a). There are several records of this species occurring near Mendota Pool. This species is also known to occur in the Chowchilla Bypass and could occur in the Eastside and Mariposa bypasses if suitable habitat is present. It is not expected to occur in the San Joaquin River corridor or the existing low-flow channel of the bypasses because these areas are regularly inundated during seasonal flood flows.

Habitat disturbance, fragmentation, and loss are the greatest threats to populations of blunt-nosed leopard lizard (USFWS 1998a). Cultivation, habitat modification for petroleum and mineral extraction; pesticide applications; use of off-road vehicles; and construction for transportation, communication, and irrigation infrastructure all have caused pervasive habitat disturbance, fragmentation, and loss throughout the San Joaquin Valley (Stebbins 1954; Montanucci 1965; USFWS 1980, 1985a; Germano and Williams 1993). These activities present ongoing threats to the survival of blunt-nosed leopard lizards (USFWS 1998a). A recovery plan was prepared by USFWS in 1980 and revised in 1985 (USFWS 1985b) and 1998 (USFWS 1998a). Conservation efforts have included habitat and population surveys, studies of population demographics, habitat management, land acquisition, and development of management plans for public lands (USFWS 1998a). Current recovery efforts focus on three important factors: (1) determining appropriate habitat management and compatible land uses for blunt-nosed leopard lizards, (2) protecting additional habitat for the species in key locations of its range, and (3) determining more precisely how populations are affected by environmental variation (USFWS 1998a).

Giant Garter Snake

Giant garter snake (*Thamnophis gigas*), which is Federally listed as threatened, historically occurred throughout the Central Valley of California, but the current range of the species is confined to the Sacramento Valley, isolated sites in the San Joaquin Valley, and potentially in the Delta (Hansen and Brode 1980; Stebbins 2003; USFWS 1999a, 1999b). It inhabits sloughs, low-gradient streams, marshes, ponds, agricultural wetlands (e.g., rice fields), irrigation canals and drainage ditches, and adjacent uplands. Although many of the populations of giant garter snake in the northern part of the range from Stockton (San Joaquin County) to Chico (Butte County) are relatively stable, the southernmost populations at the Mendota Wildlife Area (Fresno County) and the Grassland Wetlands (Merced County) are small, fragmented, unstable, and probably decreasing (USFWS 2006b). No sightings of giant garter snakes south of the Mendota Wildlife Area, in the historically known range of the species, have occurred since the time of listing (Hansen 2002).This species has been observed at the San Luis, Kesterson, and West Bear Creek units of the San Luis NWR Complex and documented in the Mendota Wildlife Area (Dickert 2005) and south of the San Joaquin River in Fresno Slough (USFWS 2006b).

Giant garter snake is threatened primarily by habitat conversion, fragmentation, and degradation resulting from urban development (58 FR 54053–54065, October 20, 1993; Dickert 2005). It is also threatened by incompatible agricultural practices, such as intensive vegetation control along canal banks and changes in crop composition. This species is susceptible to predation by native and nonnative species. It is also affected by parasites and contaminants. A draft recovery plan prepared for this species (USFWS 1999a, 1999b) is being updated and finalized. The Restoration Area is located in the San Joaquin Valley Recovery Unit (see Figure 5-2), as described in the draft recovery plan for the species. Recovery plan recommendations for this area include developing and implementing a management plan benefiting giant garter snake, restoring wetland habitat for this species, and maintaining compatible agricultural practices.

Western Yellow-Billed Cuckoo

Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), which is a candidate species for Federal listing, breeds throughout much of North America and winters in South America (Hughes 1999). The California breeding range of western yellow-billed cuckoo is restricted to the Sacramento Valley, the South Fork of the Kern River, the lower Colorado River Valley, and sometimes the Prado Basin in Riverside and San Bernardino counties (Gaines and Laymon 1984). Most recent Sacramento Valley records are from the Sacramento River, from Todd Island in Tehama County south to Colusa State Park in Colusa County, and from the Feather River in Yuba and Sutter counties (Gaines and Laymon 1984). Yellow-billed cuckoo nest sites are associated with large and wide patches of riparian habitat (Laymon and Halterman 1989). In the western United States, yellow-billed cuckoos breed in broad, well-developed, low-elevation riparian woodlands composed primarily of mature cottonwoods (*Populus* spp.) and willows (*Salix* spp.), although they have also been observed nesting in orchards adjacent to riparian habitats (Gaines and Laymon 1984). Typical nest sites in California have moderately high canopy closure and low total ground cover and are close to water (Laymon and Halterman 1987). In the late 1960s, a few yellow-billed cuckoos were observed regularly near the confluence of the Tuolumne and San Joaquin rivers, but this area was subsequently subject to intensive logging, and no cuckoos have been observed in recent years (Reeve, pers. comm., 1998, cited in McBain and Trush 2002). The yellow-billed cuckoo has been considered a rare migratory species during spring in Stanislaus County (Reeve 1988). This species has potential to nest in suitable habitat in the Restoration Area.

In California, yellow-billed cuckoo is threatened by the loss or degradation of suitable large tracts of riparian habitat, pesticide poisoning, and possibly reduced prey abundance resulting from widespread application of pesticides (Gaines and Laymon 1984). Conservation projects of the CVP have preserved habitat for yellow-billed cuckoo (DFG 2005). This species also has been included in habitat conservation and multispecies conservation planning efforts in southern California. These efforts have focused on conserving suitable breeding habitat by preserving and restoring large patches of riparian vegetation.

Least Bell's Vireo

Least Bell's vireo (*Vireo bellii pusillus*), which is Federally listed as endangered, is a neotropical migrant species and is found in California and other states in the southwest and central western United States during the breeding season and during migration. This species nests in dense, low, shrubby vegetation, generally early successional stages in riparian areas, particularly cottonwood-willow forest but also brushy fields, young second-growth forest or woodland, scrub oak, coastal chaparral, and mesquite brushlands, often near water in arid regions (Brown 1993). Formerly, the vireo was known to breed throughout the Sacramento and San Joaquin valleys, in the Sierra Nevada foothills, and in the Coast Ranges. It historically nested throughout riparian areas in the Central Valley and in other low-elevation riparian zones in California (RHJV 2004). The species was characterized as abundant at one time, but by 1980, it was extirpated from the entire Central Valley, and it is now absent from most of its historical range (RHJV 2004). Critical habitat for least Bell's vireo was designated in 1994 (59 FR 4845–4867, February

2, 1994). This critical habitat is located in southern California and does not include areas in the San Joaquin Valley. However, recent observations indicate that the species' range is expanding northward and that individuals are recolonizing areas that have been unoccupied for decades (RHJV 2004). Least Bell's vireos successfully nested at the San Joaquin River NWR in 2005 and 2006 (USFWS 2006c).

The primary threats to the least Bell's vireo are habitat loss and brood parasitism by the brown-headed cowbird (which is increased in areas with livestock) (RHJV 2004, USFWS 2006c). Threats also include habitat degradation caused by trampling of vegetation and nests by livestock and recreational activities, and habitat degradation resulting from the spread of invasive plants, in particular giant reed (*Arundo donax*). USFWS has prepared a draft recovery plan for least Bell's vireo (USFWS 1998b). Least Bell's vireo is also addressed in most habitat conservation and multiple species planning efforts in southern California (DFG 2005), including the *Coachella Valley Multi-Species Habitat Conservation Plan*, *Western Riverside Multi-Species Habitat Conservation Plan*, *Camp Pendleton Resource Management Plan*, and *Orange County Natural Community Conservation Plan*. Recovery and management recommendations in these plans include continuing cowbird removal programs, nest monitoring for cowbird parasitism, and restoration of riparian vegetation. Resolution of land use conflicts, such as those related to livestock grazing in riparian corridors, water diversion, and developed parks adjacent to suitable vireo habitat, will require additional planning and management actions.

Riparian Brush Rabbit

Riparian brush rabbit (*Sylvilagus bachmani riparius*), which is Federally listed as endangered, inhabits riparian vegetation along the lower portions of the San Joaquin and Stanislaus rivers in the northern San Joaquin Valley. Although definitive information on its former distribution is lacking, the range of this subspecies probably extended farther upstream than the Merced River, assuming that suitable habitat historically occurred along the length of the San Joaquin River system (Williams and Basey 1986). The riparian brush rabbit is restricted to several populations at Caswell Memorial State Park, near Manteca in San Joaquin County, along the Stanislaus River; along Paradise Cut, a channel of the San Joaquin River in the southern part of the Delta; and a recent reintroduction on private lands adjacent to the San Joaquin River NWR (Williams 1993, Williams and Basey 1986). A catastrophic flooding event in winter 1997 greatly reduced the numbers of riparian brush rabbit in Caswell Memorial State Park, spurring development of a captive breeding and reintroduction program. Habitat for the riparian brush rabbit consists of riparian forests with a dense understory shrub layer. Although suitable habitat is likely to be present in the Restoration Area, this species is not likely to occur there because of its limited distribution.

Potential threats to this species are habitat conversion to agriculture, wildfire, disease, predation, flooding, clearing of riparian vegetation, and the use of rodenticides. The species also is at risk from the lack of elevated mounds with protective cover to serve as flood refuges in remaining riparian habitat. A draft recovery plan has been prepared for upland and riparian species in the San Joaquin Valley, including the riparian brush rabbit (USFWS 1998a). The recovery plan includes three actions: establish an emergency plan and monitoring system to provide swift action to save individuals and habitat at Caswell

Memorial State Park in the event of flooding, wildfire, or a disease epidemic; develop and implement a cooperative program with landowners; and reevaluate the status of the rabbit within 3 years of recovery plan approval.

Fresno Kangaroo Rat

Fresno kangaroo rat (*Dipodomys nitratoides exilis*), which is Federally listed as endangered, occupies only alkali desert scrub vegetation at elevations of 200–300 feet (DFG 1992b). This species, the smallest of California's kangaroo rats, historically occurred in north-central Merced County, southwestern Madera County, and central Fresno County; however, it is believed to exist only in a small area in western Fresno County and is considered by some to be extirpated from along the San Joaquin River (McBain and Trush 2002). This species was captured at the Alkali Sink Ecological Reserve and Mendota Wildlife Management Area near the Restoration Area in 1981, 1985, and 1992, but extensive trapping since 1993 in Fresno and Madera counties have not documented additional kangaroo rats (McBain and Trush 2002). Critical habitat for this species has been established in and near the Mendota Wildlife Area, approximately 1.75 miles southeast of Reaches 2A and 2B (Figure 5-3). The primary threats affecting the Fresno kangaroo rat are habitat loss related to conversion to developed or agricultural land uses, and incompatible grazing practices, and potentially the illegal use of rodenticides (USFWS 1998a). Flooding of habitat by the San Joaquin River has also been considered a potential threat. A recovery strategy for Fresno kangaroo rat has been developed by USFWS and was included in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a). This strategy relies on additional preservation, restoration, and enhancement of habitat, and possibly reintroduction of Fresno kangaroo rats to restored but unoccupied habitat. Obtaining additional information on the distribution and abundance of Fresno kangaroo rats is also a component of the recovery strategy, as is developing management prescriptions for the species and continued monitoring of its abundance.

San Joaquin Valley (Riparian) Woodrat

San Joaquin Valley (or riparian) woodrat (*Neotoma fuscipes riparia*), which is Federally listed as endangered, was historically found along the San Joaquin, Stanislaus, and Tuolumne rivers and likely occurred throughout the riparian forests of the northern San Joaquin Valley (USFWS 1998a). Its range has become much more restricted because of extensive modification and destruction of riparian habitat along streams in its former range in the Central Valley. The only verified extant population is restricted to approximately 250 acres of riparian forest in Caswell Memorial State Park on the Stanislaus River, at the confluence with the San Joaquin River (USFWS 1998a). This species is most abundant in areas with deciduous valley oaks and some live oaks and with dense shrub cover. In riparian areas, the highest densities of woodrats and their houses are typically in willow thickets with an oak overstory. There are no documented CNDDB occurrences of San Joaquin Valley woodrat in or in the vicinity of the Restoration Area, although it could occur in suitable habitat.

Potential threats to this species include habitat conversion to agriculture, wildfire, disease, predation, flooding, drought, clearing of riparian vegetation, use of rodenticides, and browsing and trampling by ungulates (USFWS 1998a). A recovery strategy for San

Joaquin Valley woodrat has been developed by USFWS and was included in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a). This strategy relies on additional preservation, restoration, and enhancement of habitat and possibly reintroduction of this woodrat to restored but unoccupied habitat. Reducing habitat fragmentation and conserving corridors of riparian habitat are important components of this strategy. Collaboration with landowners and levee maintenance districts is also a component of the recovery strategy.

San Joaquin Kit Fox

San Joaquin kit fox (*Vulpes macrotis mutica*), which is Federally listed as endangered, is presumed to have historically ranged from Contra Costa and San Joaquin counties in the north to Kern County in the south, and along the coast in Monterey, Santa Clara, and Santa Barbara counties. In portions of this geographic range, the San Joaquin kit fox still occurs in seasonal wetland, alkali desert scrub, grassland, and valley-foothill hardwood vegetation. Its optimum habitat consists of a variety of open, level areas with loose-textured soil, scattered shrubby vegetation, and little human disturbance. The San Joaquin kit fox has been observed in and adjacent to the West Bear Creek Unit of the San Luis NWR Complex (McBain and Trush 2002). Numerous additional records exist for this species in and adjacent to the Restoration Area, including records of active dens. Although most of these records are more than 15 years old (CNDDB 2009), this species is likely to be present in suitable habitat in the Restoration Area.

Loss and degradation of habitat by agricultural, industrial, and urban development and associated practices continue, decreasing the carrying capacity of remaining habitat and threatening kit fox survival (USFWS 2007). Such losses contribute to kit fox declines through displacement, direct and indirect mortalities, introduction of barriers to movement, and reduction of prey populations. San Joaquin kit fox is also threatened by rodenticide use and by competitive displacement or predation by other species, such as the nonnative red fox (*Vulpes vulpes*), coyote (*Canis latrans*), domestic dog (*C. familiaris*), bobcat (*Felis rufus*), and large raptors. A recovery strategy for San Joaquin kit fox has been developed by USFWS and was included in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a). This strategy relies on enhanced preservation and management of three core populations, and an important component of this preservation and management is sustaining and increasing habitat connectivity. Gathering additional information on the distribution and movement of kit foxes is also a component of the recovery strategy, along with developing restoration and management prescriptions for the species.

6.0 Effects

As described in Section 1.3, “Action Area,” implementing WY 2010 Interim Flows under the SJRRP may affect Federally listed species in the following areas:

- Millerton Lake and the San Joaquin River between Kerkhoff Dam and Millerton Lake.
- San Joaquin River from Friant Dam downstream to the Delta.
- Eastside Bypass downstream from the Sand Slough Control Structure, and the Mariposa Bypass.
- Merced, Tuolumne, and Stanislaus rivers downstream from New Exchequer, Don Pedro, and New Melones dams, respectively.
- South and central Delta, defined as the San Joaquin River and its tributaries within the Delta west to its confluence with the Sacramento River.

This chapter analyzes the direct effects that would result from WY 2010 Interim Flows after incorporation of conservation measures developed to minimize potential effects on listed species (see Section 3.5.2, “Conservation Measures for Listed Species”). The proposed project is not expected to have any indirect effects because the release of the WY 2010 flows is not expected to result in any measureable changes later in time to water levels, riparian vegetation, or other habitat conditions for listed species. Other activities that are interrelated or interdependent with the WY 2010 Interim Flows were considered for their potential to affect listed species.

In addition to evaluating the potential effects on species and their habitats, this chapter evaluates the effect of the WY 2010 Interim Flows on designated critical habitat and essential fish habitat. USFWS and NMFS define “adversely affect” as it applies to critical habitat as follows:

> *[A] direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical.*

6.1 Direct and Indirect Effects

Direct effects are defined as those effects which will have an immediate effect on the species or its habitat as a result of the proposed project activities. Indirect effects are those effects which are caused by, or result from the proposed project activities, are later in time, and are reasonably certain to occur. Direct and indirect effects for both aquatic and terrestrial species are described below.

6.1.1 Aquatic Species

Delta Smelt

The potential direct and indirect effects of implementing the WY 2010 Interim Flows on delta smelt are described below.

Delta Flow Patterns. Patterns of flow circulation in the Delta strongly affect fish distribution and migration behaviors. The largest flows in the Delta are tidal flows, which far exceed other flows in most Delta channels, but the nontidal flows determine the net direction of water movement and thereby affect fish movements.

Increased San Joaquin River flow may affect Delta outflow and X2. X2 is largely determined by Delta outflow and is often used to index the location of the LSZ (Kimmerer 2004). The LSZ is an area of historically high prey densities and other favorable habitat conditions for a number of Delta fish species, including delta smelt (Kimmerer 2004). However, the contribution of the San Joaquin River to Delta outflow is much smaller than that of the Sacramento River, so any effect of WY 2010 Interim Flows on Delta outflow or X2 would be negligible.

The south Delta is generally considered poor habitat for delta smelt relative to other parts of the Delta (Feyrer 2004, Monson et al. 2007, Nobriga et al. 2008) because of risk of entrainment, high water temperatures during summer and fall, and increased predation. Predation is increased because (1) water clarity is generally higher in the south Delta (Feyrer, Nobriga, and Sommer 2007, Nobriga et al.2008), making the prey fish more visible to their predators; (2) Clifton Court Forebay, the fish louver screens at the Jones and Banks facilities, and other facilities and structures in the south Delta concentrate and disorient prey fish and provide ambush sites for predacious fish; and (3) recent invasions by the submerged plant *Egeria densa* provide favorable habitat conditions for black bass species, which prey heavily on young life stages of most fish species (Nobriga et al. 2005). The increased risks of entrainment and predation and the high summer water temperatures reduce the fitness of delta smelt residing in the south Delta. Therefore, delta smelt benefit from flow patterns that lower their occurrence in the south Delta.

In years with relatively high Delta outflow, most delta smelt spawning occurs in Suisun Bay, but in years of low Delta outflow, they spawn farther upstream, including in the lower Sacramento and San Joaquin rivers. Therefore, except during years of high outflow, adult delta smelt are most likely to occur in the south Delta when they migrate upstream in December through April and before the larvae and juveniles have migrated downstream, which is usually largely complete by June. Delta smelt that spawn in the vicinity of the lower San Joaquin River are most at risk of being drawn into the south Delta by reverse flows. Larvae are slowly transported downstream as they develop. However, larvae and many juveniles remain in upstream portions of the Delta for a month or more, particularly in years with low Delta inflow. During such periods, they are at risk of being transported by reverse flows to the south Delta and the export pumps.

Changes in south and central Delta flow patterns resulting from implementing the WY 2010 Interim Flows are expected to reduce the incidence of delta smelt in the south Delta, where entrainment and predation risks are high and summer water temperatures are unsuitable for the species. Therefore, the flow patterns expected under the WY 2010 Interim Flows are anticipated to have a beneficial effect on delta smelt and its critical habitat. There would be no adverse effect on delta smelt resulting from Delta flow patterns.

Water Temperature and Dissolved Oxygen. The south Delta typically has poor water temperature conditions for delta smelt, especially during late summer and early fall (Nobriga et al. 2008, Feyrer 2004, Kimmerer 2004). Water temperatures would be not be affected in the south Delta by implementing the WY 2010 Interim Flows.

Implementing the WY 2010 Interim Flows would potentially improve DO conditions in the San Joaquin River near the Stockton DWSC. DO levels at the Stockton DWSC are often low during late summer and early fall because of high water temperatures and algal biomass and low river flow (Giovannini 2005, Lee and Jones-Lee 2003). San Joaquin River inflow to the Delta is expected to increase under the WY 2010 Interim Flows. It is assumed that operations of the Head of Old River Barrier, which is installed during fall of most years to increase San Joaquin River flow past Stockton, would not change. The increased flow would likely lead to higher DO levels at the Stockton DWSC, which would benefit fish residing in this area. However, delta smelt rarely occur in this area and therefore would not be affected.

Implementing the WY 2010 Interim Flows is expected to have no effect on water temperatures in the Delta but would likely help to alleviate the low DO conditions at the Stockton DWSC during late summer and fall. Delta smelt rarely occur in this part of the Delta, so the WY 2010 Interim Flows will not result in any effects beyond those covered in the USFWS 2008 OCAP BO.

Contaminants. Implementing the WY 2010 Interim Flows would increase San Joaquin River flow, which would dilute contaminants from agricultural drainage or other sources. This effect likely would not extend far into the Delta, because much of the increased water volume would be offset by exports at the Jones and Banks facilities. Few delta smelt occur in the portion of the Delta affected by the dilution effects; therefore, the WY 2010 Interim Flows are not likely to result in effects beyond those described in the USFWS 2008 OCAP BO.

Predation. The potential effects of implementing the WY 2010 Interim Flows on predation of delta smelt may be determined by the effect of the flows on the distribution of delta smelt in the south Delta. Increased flows in the San Joaquin River through the Delta are expected to reduce the incidence of delta smelt in the south Delta. Therefore, the WY 2010 Interim Flows are not likely to result in effects beyond those described in the USFWS 2008 OCAP BO.

Food Resources. Implementing the WY 2010 Interim Flows may have two potential effects on the availability of *Pseudodiaptomus,* the food resource for delta smelt, in the south Delta. Increased diversion at the Jones and Banks export facilities would likely entrain high numbers of copepods, including *Pseudodiaptomus*, and reduce their abundance. However, the increased San Joaquin River flows would more rapidly transport copepods produced in the south and central Delta downstream to delta smelt foraging areas in Suisun Bay and the lower Delta. The effects of increased entrainment of *Pseudodiaptomus* and more rapid downstream transport of the copepods would result in no net effect on delta smelt food resources. Therefore, the WY 2010 Interim Flows are not likely to result in effects beyond those described in the USFWS 2008 OCAP BO.

Central Valley Steelhead DPS

The geographic range and designated critical habitat of Central Valley steelhead overlap the Action Area in the south and central Delta.

San Joaquin River Flow Upstream from the Merced River Confluence. Implementing the WY 2010 Interim Flows would increase flows in the section of the San Joaquin River from Friant Dam to the Delta. Segments of the San Joaquin River upstream from the Merced River are currently often dry. The WY 2010 Interim Flows would occur from October 1 through November 20, 2009, and begin again on February 1, 2010. Flows immediately upstream from the Merced River confluence increased by an average of 220 cfs in February to a maximum of an average of approximately 1,250 cfs in April.

Increased flows in the San Joaquin River downstream from the Merced River confluence would improve overall conditions for migrating adult and juvenile steelhead by improving water quality, and slightly higher water velocities. This would likely reduce or prevent migration delays by both adults and juveniles.

Increased flows upstream from the Merced River confluence may potentially trigger adult Central Valley steelhead migrating toward the Merced River to stray into the San Joaquin River upstream from the confluence. Such straying would potentially reduce the Merced River population. However, the WY 2010 Interim Flows would be provided primarily outside the November-through-January period of steelhead upstream migration. In addition, the Hills Ferry Barrier operations would continue in fall (during the WY 2010 Interim Flows) to prevent the unwanted upstream migration of Central Valley steelhead past the Merced River confluence during mid-September through early December, when the barrier is operational.

Central Valley steelhead juveniles, including smolts, emigrating from the Merced River could also stray into the San Joaquin River mainstem upstream from the confluence, although juveniles generally migrate with the flow, which reduces the risk of upstream straying. Because few juvenile Central Valley steelhead have ever been observed in the San Joaquin River upstream from the Merced River confluence, implementing the WY 2010 Interim Flows would not include deployment of the Hills Ferry Barrier during spring Interim Flows.

Because of measures adopted to prevent straying of Merced River adult steelhead into the San Joaquin River upstream from the confluence, implementing the WY 2010 Interim Flows is not likely to adversely affect straying of Central Valley steelhead.

Flow in the Lower San Joaquin River and Tributaries. Tributary releases to meet VAMP water quality objectives at Vernalis would be affected in one of two ways. In conditions where WY 2010 Interim Flows contribute toward meeting the same VAMP flow threshold that would have otherwise been in place, required releases from tributary reservoirs could be reduced. In conditions where WY 2010 Interim Flows cause a higher VAMP flow threshold than would have otherwise been in place, required releases from tributary reservoirs would be made to achieve the higher threshold. Changes in VAMP contribution releases from tributary reservoirs would not affect the ability to meet instream fish and water quality minimum flow requirements in the Merced, Tuolumne, or Stanislaus rivers.

Similarly, increased flows in the lower San Joaquin River resulting from implementing the WY 2010 Interim Flows would improve water quality conditions upstream from the Stanislaus River, thereby reducing required flow releases from New Melones Reservoir pursuant to D-1422 to achieve water quality objectives at Vernalis. These changes would not affect the ability to meet instream fish and water quality minimum flow requirements in the Stanislaus River.

Because minimum instream flow requirements and water quality standards would continue to be met, changes in San Joaquin River flow resulting from implementing the WY 2010 Interim Flows are not likely to adversely affect Central Valley steelhead or its designated critical habitat.

Delta Flow Patterns. Central Valley steelhead migrate through the Delta as adults moving upstream to spawn and as juveniles and smolts emigrating on their way to the ocean. Most Central Valley steelhead spawn in the Sacramento River and its tributaries, but the effects of implementing the WY 2010 Interim Flows on these fish would be less substantial than on those spawning in the San Joaquin River basin, so this analysis will focus on the San Joaquin River basin spawners. The spawning migrations bring the steelhead to the Delta in November through January, and the emigration of smolts occurs during spring, peaking in April and May.

The direct effects of implementing the WY 2010 Interim Flows in the Delta would include increased inflow from the San Joaquin River and increased exports at the Jones and Banks export facilities (see Section 3.3, “Proposed Action”). The export facilities are located in the southwestern Delta and are connected by Old and Middle rivers to the San Joaquin River close to where it enters the southeastern Delta. The facilities are also connected by the same two rivers to a more downstream reach of the San Joaquin River. Other channels between these locations connect the middle reach of the river to the export facilities. When the export pumps are not operating, flow in Old and Middle rivers moves from the upstream portions that join the San Joaquin River in the southeastern Delta to the downstream portions that join the lower portion of the river. However, when the pumps are operating, they often export such large volumes of water that flow in the downstream portions of Old and Middle rivers moves upstream toward the pumps.

The 2008 OCAP BO for delta smelt places restrictions on reverse flows in the downstream Old and Middle rivers, which helps to indirectly protect steelhead trout.

Increased flows often help trigger adult steelhead to begin moving upstream, so increased San Joaquin River inflow during late fall and winter would potentially help to initiate the spawning migrations. Increased inflow also potentially would provide stronger environmental cues that would help to keep the salmon from straying out of the river channel into the south Delta. However, when export pumping is increased to recirculate San Joaquin River inflow, increased flow toward the pumps in upper Old and Middle rivers would potentially cause increased straying of the migrating adults into the south Delta, where their progress would be potentially impeded by barriers and irregular flow patterns (Mesick 2001).

Reverse flows lower Old and Middle rivers, north of the south Delta export facilities, draw some Sacramento River water from upstream of the confluence of the Sacramento and San Joaquin rivers through the Delta Cross Channel and Georgiana Slough into the San Joaquin side of the Delta. After the Sacramento River water reaches the confluence, the reverse flows may draw more of this water upstream into the San Joaquin River and the south Delta. These flows likely cause straying and delays in the migrations of Sacramento River Central Valley steelhead (Brandes and McLain 2001). However, as a result of the 2008 OCAP BO for delta smelt, reverse flows in Old and Middle River will be regulated, restricting the potential effect of the WY 2010 Interim Flows on these flows. Therefore, implementing the WY 2010 Interim Flows is not likely to adversely affect Central Valley steelhead from the Sacramento during their upstream or downstream migrations through the Delta.

Migrations of adult San Joaquin River fall-run salmon are often delayed by low DO levels near the Stockton DWSC during the September-through-November migration period (Giovannini 2005). Low DO at this location is less likely to affect migrating adult steelhead because water temperatures are generally lower and flows are often higher during the period that the steelhead migrate.

Increased San Joaquin River inflow would likely benefit emigrating Central Valley steelhead. Tagging studies conducted for VAMP have demonstrated that fall-run Chinook smolt survival through the south and central Delta is positively correlated with San Joaquin River inflow (SJRGA 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009). Higher inflow likely reduces the transit time of the smolts through the Delta, thus reducing their time of exposure to predators, poor water quality, low food supply, and other mortality factors. High inflow also helps to prevent straying into the south Delta, where habitat conditions are especially poor and risks of entrainment greatly increase. Effects of increased San Joaquin River inflow on Central Valley steelhead emigrating from the San Joaquin River are expected to be similar.

Although increased San Joaquin River inflow would potentially improve conditions for emigrating steelhead, the increased flows in upper Old and Middle rivers resulting from the higher levels of pumping required to recirculate the San Joaquin River water would potentially increase rates of straying by the smolts, which would potentially negate any benefit derived from higher inflows. Straying of smolts into the south Delta would likely increase entrainment and predation risks and delay migrations. The positive and negative effects of the changes in Delta flow patterns are expected to offset each other and therefore are considered not likely to adversely affect the steelhead smolts.

Water Temperature and Dissolved Oxygen. Implementing the WY 2010 Interim Flows would result in increased flow in the lower San Joaquin River and the Delta. The .increased flow would help to buffer the river from changes in heating inputs and thereby moderate temperature changes.

Implementing the WY 2010 Interim Flows would potentially increase DO levels in the San Joaquin River near the Stockton DWSC. DO levels at the Stockton DWSC are often low during late summer and early fall because of high water temperatures and algal biomass and low river flow (Giovannini 2005, Lee and Jones-Lee 2003). San Joaquin River inflow is expected to increase under the WY 2010 Interim Flows. It is assumed that operations of the Head of Old River Barrier, which is installed during fall of most years to increase San Joaquin River flow past Stockton, would not change. The increased flow would likely lead to higher DO levels at the Stockton DWSC, which would benefit adult Central Valley steelhead migrating through this area. However, low DO at the Stockton DWSC is rarely a problem during November through January, when adult steelhead are migrating upstream, so there would be little effect of the change in summer-through-fall DO levels on steelhead.

Implementing the WY 2010 Interim Flows is expected to have no effect on water temperatures in the lower San Joaquin River or the Delta, but it would likely alleviate the low DO conditions at the Stockton DWSC during late summer and fall. There would be no effect on Central Valley steelhead or its designated critical habitat.

Contaminants. Implementing the WY 2010 Interim Flows would increase San Joaquin River flow, which would dilute contaminants from agricultural drainage or other sources. Therefore, it would likely have a beneficial effect on Central Valley steelhead and its designated critical habitat in the lower San Joaquin River. The effect would likely not extend far into the Delta, because much of the increased water volume would be offset by exports at the Jones and Banks facilities.

Predation. The potential effects of implementing the WY 2010 Interim Flows on predation of Central Valley steelhead smolts are expected to be largely determined by the effects of the flows on the straying of smolts into the south Delta. Predation rates are higher for most fishes in the south Delta than in other parts of the Delta for a variety of reasons: (1) turbidity is generally lower in the south Delta, so fish are more visible to their predators (Nobriga et al. 2008, Feyrer, Nobriga, and Sommer2007); (2) many of the structures and facilities in the south Delta concentrate or disorient prey fish and provide ambush sites for predacious fish, particularly Clifton Court Forebay and the fish louver screens at the Jones and Banks export facilities (Reclamation 2008); and (3) recent invasions by the submerged plant *Egeria densa* provide favorable habitat conditions for black bass species, which prey heavily on young fish life stages (Nobriga and Feyrer 2007, Nobriga et al. 2005). The effects of increased San Joaquin River flows and increased flows in Delta channels leading into the south Delta are expected to offset one another, resulting in no change in smolt straying into the south Delta. Therefore, implementing the WY 2010 Interim Flows is considered not likely to adversely affect predation on Central Valley steelhead smolts.

Sacramento River Winter-Run Chinook Salmon ESU and Central Valley Spring-Run Chinook Salmon ESU

The ranges of both Sacramento River winter-run and Central Valley spring-run Chinook salmon overlap very little with the Action Area. Both runs spawn in the Sacramento River or its tributaries, and both use the Sacramento River as a migration corridor through the Delta. However, both upstream migrating adults and outmigrating smolts do stray into the Action Area, particularly when the DCC gates are open and/or south Delta export rates are high relative to San Joaquin River inflow, which causes highly negative flows in the Old and Middle rivers north of the export facilities. Potential effects of implementing the WY 2010 Interim Flows on these runs are similar and are the same as those previously described for Central Valley steelhead from the Sacramento River, except that the timings of migrations are different.

Winter-run Chinook salmon migrate upstream through the Delta from approximately December through June, and the smolts emigrate through the Delta from January through May. Implementing the WY 2010 Interim Flows is expected to increase San Joaquin River inflow and increased flow in the river through the Delta. No changes of flows in the Old and Middle rivers in the central Delta or in operation of the DCC are anticipated. Therefore, fewer adults or smolts would be likely to stray from the Sacramento River into the San Joaquin River side of the Delta, reducing transit time and improving survival. The effect on straying is expected to be small; therefore, implementing the WY 2010 Interim Flows is considered not likely to adversely affect Sacramento River winter-run Chinook salmon or its designated critical habitat.

Spring-run Chinook salmon migrate upstream through the Delta from approximately March through June. Timing of smolt emigration is variable because smolt may emigrate as young-of-the-year or as yearlings (Reclamation 2008). As a result, most spring-run emigration occurs either during November and December or during March through May. As indicated for winter-run Chinook salmon, implementing the WY 2010 Interim Flows is expected to increase San Joaquin River inflow and increased flow in the river through the Delta, which would potentially reduce straying from the Sacramento River. The effect on straying is expected to be small; therefore, implementing the WY 2010 Interim Flows is considered not likely to adversely affect Central Valley spring-run Chinook salmon or its designated critical habitat.

Southern DPS of the North American Green Sturgeon

Adult green sturgeon migrate up the Sacramento River to spawn from April through June (Moyle 2002). It is unknown whether the species spawns in the San Joaquin River. Juveniles are entrained in the Jones and Banks export facilities, but numbers are low relative to those of most Delta species. It may be assumed that sturgeon are adversely affected by the same poor conditions in the south Delta that affect other species and that they would similarly benefit from conditions that reduced their exposure to this portion of the Delta. Adult and juvenile green sturgeon may be found in the Delta at any time of year.

Because they reside in the Delta throughout the year, green sturgeon would be potentially affected by changes in Delta flow patterns resulting from implementing the WY 2010 Interim Flows in any month. Whether San Joaquin River inflows and increased flows in the southeast Delta channels leading into the south Delta affect movement of adult or juvenile green sturgeon is unknown, but it is assumed that they do. As previously described for delta smelt and Central Valley steelhead, flow conditions expected under the WY 2010 Interim Flows would likely result in reduced movement to the south Delta or no change in such movement, and it is expected that this also would be true for green sturgeon. Therefore, implementing the WY 2010 Interim Flows is considered not likely to adversely affect Southern DPS of the North American green sturgeon or its designated critical habitat.

6.1.2 Effects of Proposed Action on EFH

Increased flows will directly benefit EFH for Pacific salmon in the Action Area in the same manner as described above for all ESUs of Chinook salmon. There would be no direct effect to starry flounder EFH.

6.1.3 Terrestrial Species

With implementation of WY 2010 Interim Flows, the annual reduction in water-surface elevation of Millerton Lake would occur earlier in the year. However, fluctuations in Millerton Lake and the San Joaquin River upstream to Kerkhoff Dam would remain within historical levels. WY 2010 Interim Flows would not result in inundating areas that are not regularly inundated or result in drying of areas that are not regularly subject to drying from reservoir draw down under current operation of Friant Dam. Between the Merced River and the Delta, the increase in San Joaquin River flow would be small relative to the seasonal and interannual variation in flow along this segment of the river. The additional water resulting from WY 2010 Interim Flows would become a progressively smaller portion of the San Joaquin River's total flow as additional water enters the river from major tributaries (i.e., the Merced, Tuolumne, and Stanislaus rivers).The increased flow would also be much smaller than flood flows that currently occur every 2 to 5 years along this segment of the San Joaquin River. WY 2010 Interim Flows would not be released during periods of flood flows. It is anticipated that WY 2010 Interim Flows would create additional flood storage space in Millerton Lake.

Effects of the Proposed Action on the hydrology of the Tuolumne, Stanislaus, and Merced rivers would be much less than on the hydrology of the lower San Joaquin River. With implementation of WY 2010 Interim Flows, more water from the San Joaquin River could flow downstream from the Merced River confluence; as a result, less water would need to be released from New Exchequer, Don Pedro, and New Melones dams into the Merced, Tuolumne, and Stanislaus rivers to meet minimum flow requirements and water quality standards in the San Joaquin River. However, any changes in flow originating from these rivers would be well within the historic fluctuation levels and would last for only a single year. The resulting alterations to environmental conditions would not be sufficient to adversely affect riparian habitats or otherwise affect listed species.

Implementing WY 2010 Interim Flows could increase water flow from the San Joaquin River into the Delta. However, these additional inflows would not significantly change water surface elevations, water quality, or other ecologically important conditions in the Delta for terrestrial species. The additional flow into the Delta as a result of WY 2010 Interim Flows would be insufficient to alter habitat conditions and vegetation or to otherwise affect listed terrestrial species in the Delta, which currently is subject to varying water levels.

Vernal Pool Plant Species

Six vernal pool plant species are known or have potential to occur in the Action Area: succulent owl's clover, hairy orcutt grass, San Joaquin Valley orcutt grass, Hoover's spurge, Colusa grass, and Greene's tuctoria.

Suitable habitat for succulent owl's clover and San Joaquin Valley orcutt grass is located in northern hardpan and northern claypan vernal pools found on alluvial terraces adjacent to Reach 1A of the San Joaquin River, and in northern basalt flow vernal pools on tabletops above the river and Millerton Lake between Kerkhoff Dam and Friant Dam. Northern hardpan and northern claypan vernal pool habitats on alluvial terraces adjacent to Reach 1A are also potentially suitable for hairy orcutt grass; however, this species does not occur in basalt flow vernal pools and has a lower elevation range limit than succulent owl's clover and San Joaquin Valley orcutt grass. Suitable vernal pool habitats for these three species are located outside of the portion of river channel that would be inundated by WY 2010 Interim Flows and outside of the fluctuation zone of Millerton Lake.

Hoover's spurge and Colusa grass are known to occur in the vicinity of the Restoration Area in the Merced NWR, and potentially suitable habitat for these species exists in northern hardpan and northern claypan vernal pools on alluvial terraces in and adjacent to Reach 4B2 and the Eastside and Mariposa bypasses. Although, potentially suitable vernal pool habitat for Hoover's spurge is presumably present, the likelihood that Hoover's spurge is present in the Action Area is low because the Merced NWR occurrence is the only one out of 29 occurrences documented in the CNDDB that is located in the San Joaquin Valley Vernal Pool Region (USFWS 2005). This single occurrence is located approximately 1.5 miles east of the Eastside Bypass, but not within the action area. This species is associated primarily with vernal pools of the Northeastern Sacramento Valley Vernal Pool Region in Butte and Tehama counties and the Southern Sierra Foothills Vernal Pool Region in Tulare County. The majority of known occurrences (58 percent) are found in the Northeastern Sacramento Valley Vernal Pool Region; the remaining occurrences are in the Southern Sierra Foothills and Solano-Colusa vernal pool regions (USFWS 2005). Colusa grass could be present in any suitable vernal pool habitat in or adjacent to the Eastside Bypass, though it has not been documented there, but suitable habitat for Colusa grass and Hoover's spurge is not expected to occur within the low-flow channels where Interim Flows would be conveyed.

Historic occurrences of Greene's tuctoria have been documented in the vicinity of the Tuolumne River in Stanislaus County. However, these occurrences are believed to be extirpated from the county (USFWS 2005). No extant occurrences of Greene's tuctoria are known within the Action Area, and Interim Flows are not expected to result in substantial changes in the timing or duration of flooding along the Tuolumne River. Any changes in hydrology within the tributary rivers of the San Joaquin River would be within the normal range of fluctuation for these rivers. No known occurrences of Greene's tuctoria exist in the vicinity of the San Joaquin River. Therefore, Interim Flows would not result in adverse effects on Greene's tuctoria.

All of the vernal pool plant species discussed here are adapted to ephemeral wetland habitats (i.e., habitats that become inundated during winter rains, then dry out completely by summer) and require the specific type of hydrologic regime found in vernal pools to successfully complete their life cycles. Vernal pool hydrology is characterized by unique patterns of filling and drying that do not occur in riverine wetlands or wetlands that are permanently inundated or saturated. Vernal pools are filled primarily through direct precipitation during winter and dry as a result of evaporation during spring and early summer. These hydrologic requirements do not occur in low-flow river channels that are typically flooded longer than vernal pools and convey high-velocity flows for a portion of the season. Therefore, suitable habitat for vernal pool plant species is not expected to be present in the low-flow channels that would convey WY 2010 Interim Flows.

The San Joaquin River downstream from Friant Dam is currently and historically has been managed to convey flows much later into spring and summer than ephemeral wetland habitats that support vernal pool plant species. Because plants endemic to vernal pools are not adapted to riverine habitats that are periodically flooded in summer and convey high-velocity flows, vernal pool plant species are not expected to be present within the low-flow channel. Releases of Interim Flows would be restricted to existing low-flow channels in the San Joaquin River and the bypasses and would avoid inundating vernal pools. Seepage and vegetation monitoring surveys would be conducted during releases of Interim Flows to determine whether Interim Flows need to be reduced to avoid affecting vernal pool habitats, as described in Section 3.5.2. Therefore, WY 2010 Interim Flows would not directly or indirectly affect aquatic habitat for vernal pool plant species and would not affect vernal pool plants.

Succulent owl's clover is believed to be self-pollinating, and Colusa grass, Greene's tuctoria, and the orcutt grasses are wind pollinated. Therefore, pollinators of these species would not be affected. Hoover's spurge is believed to be pollinated by various insects. Butterflies and moths, flies, beetles, bees, and wasps have all been observed visiting Hoover's spurge (USFWS 2005). WY 2010 Interim Flows is unlikely to flood substantial amounts of vegetation that could support insect pollinators of Hoover's spurge because flows would be restricted to the low-flow channel, which is typically kept clear of such vegetation by the presence of water, regular maintenance of the channel for conveyance, and periodic floods; therefore, the proposed action is not likely adversely affect insect pollinators.

Critical Habitat for Vernal Pool Plan Species. All critical habitat designated for San Joaquin Valley orcutt grass is outside the Restoration Area. Critical habitat for succulent owl's clover, hairy orcutt grass, and San Joaquin Valley orcutt grass has been designated in the Restoration Area on alluvial terraces adjacent to Reach 1A of the San Joaquin River. The critical habitat for these three species in this area overlaps considerably, but is not identical for each species. A small portion of critical habitat for succulent owl's clover (42 acres in Unit 4) and hairy orcutt grass (3 acres in Unit 6) extends along the north bank of the San Joaquin River in Reach 1A. The amount of critical habitat that could be affected by WY 2010 Interim Flows was estimated by calculating the amount of critical habitat within the river channel at the approximate ordinary high water mark. In addition, the Action Area includes designated critical habitat for succulent owl's clover in the Merced River and for hairy orcutt grass in the Tuolumne River. This is a very small fraction of the critical habitat designated for these species (Table 6-1).

The PCEs for these species, as well as the other vernal pool plants and invertebrates evaluated in this BA, generally include: (1) topographic features characterized by mounds, swales, or depressions within a matrix of surrounding uplands and (2) depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water or whose soils are saturated for a temporary period. The action area is unlikely to contain these PCEs because vernal pools, swales, or other seasonal wetlands within an upland matrix are not found within the low-flow channel of riverine habitats or the bypasses.

Because the WY 2010 Interim Flows would be restricted to the low-flow channel and the PCEs of critical habitat for vernal pool plant species are not likely to be present in the low-flow channel, the proposed action would not likely have an adverse direct or indirect effect on critical habitat for succulent owl's clover or for hairy orcutt grass.

Table 6-1.
Critical Habitat for Vernal Pool Plants in the Action Area

Species	Unit Number	Total Acres in Unit	Location	Maximum Acres Designated Within Action Area[1]	Maximum Percent Within Action Area
Succulent owl's clover	4C	38,038	San Joaquin River Reach 1A	41	0.1
	3B	71,947	Merced River	7	0.01
Hairy orcutt grass	6	27,033	San Joaquin River Reach 1A	3	0.0
	4A	47,399	Tuolumne River	6	0.01
Hoover's spurge	6A	1,617	San Joaquin River Reach 4B2 and Eastside Bypass	35	2.2
	6B	6,030	San Joaquin River Reach 4B2 and Eastside and Mariposa Bypasses	501	8.3
	6C	6,911	Eastside Bypass	9	0.1
	4	37,595	Tuolumne River	14	0.04
	5A	33,381	Tuolumne River	6	0.02
Colusa grass	7D	6,911	Eastside Bypass	9	0.1
	6	54,119	Merced River	7	0.01
	4D	43,315	Tuolumne River	16	0.03
	5B	33,891	Tuolumne River	6	0.02
Greene's tuctoria	6D	44,517	Tuolumne River	14	0.03
	7	86,636	Merced River	7	0.01

Notes:
[1] Based on the published ordinary high water mark of the San Joaquin, Tuolumne, Merced, and Stanislaus rivers and aerial photo interpretation of levee boundaries of Eastside and Mariposa Bypasses. Because WY 2010 Interim Flows would not inundate this entire area (e.g., OHWM of San Joaquin River or bank-full levees in the bypasses), these calculations over-estimate the potential acreage of critical habitat that could be affected. Furthermore, the low-flow channels of the rivers and bypasses are unlikely to contain the PCEs of the designated critical habitats for the listed vernal pool species.

Critical habitat for Hoover's spurge has been designated in and adjacent to the Eastside and Mariposa bypasses and Reach 4B2 of the San Joaquin River (Table 6-1). Approximately 2.2 percent of Unit 6A (1,617 acres total), 8.3 percent of Unit 6B (6,030 acres total), and 0.1 percent of Unit 6C (6,911 acres total) is within the levees of the Eastside Bypass and therefore could be directly affected by WY 2010 Interim Flows; however, the WY 2010 Interim Flows would be confined to the low-flow channel and would not inundate the full width of the levees, so this approximation of acreage potentially affected is an over-estimation. In addition, WY 2010 Interim flows are unlikely to affect the PCEs of the critical habitat designations because vernal pool habitats are not found within the low-flow channel of the bypasses.

Critical habitat for Colusa grass has been designated in and adjacent to the east bank of the Eastside Bypass. The estimated amount of designated critical habitat for Colusa grass within the action area is approximately 9 acres in Unit 7D out of a total 6,902 acres present in the area, or 0.1 percent (Table 6-1).

In addition, within the Action Area, designated critical habitat is present for Hoover's spurge on the Tuolumne River, and for Colusa grass on the Merced and Tuolumne rivers (Table 6-1).

Although the critical habitat designated for these two species extends into the Restoration Area, suitable vernal pool habitat or the PCEs of the designation are not expected to be present within the low-flow channels to which Interim Flows would be restricted. Critical habitat for Colusa grass is designated well outside the low-flow channel of the Eastside Bypass and would not be affected by WY 2010 Interim Flows.

Critical habitat for Greene's tuctoria has been designated within the Action Area along the Merced and Tuolumne rivers. However, suitable vernal pool habitat for Greene's tuctoria is not expected to occur within the low-flow channels of these rivers, and changes in flow regime resulting from Interim Flows are not expected outside of the low-flow channels. The low-flow channel is unlikely to contain the PCEs of the critical habitat designation. At maximum flow velocity, which occurs during spring, modeling shows that Interim Flows would remain within the low-flow channels of the San Joaquin River and bypasses. Changes in flow velocity would be much less in tributaries than in the San Joaquin River and bypasses; therefore WY 2010 Interim Flows would not cause substantial changes in flow regime in these tributaries even during spring flows. Also, WY 2010 Interim Flows would not increase flood flow levels because they would not be released during periods of flood flows.

The Proposed Action could increase flood duration within the low-flow channels of the San Joaquin River and the Eastside and Mariposa bypasses during WY 2010 only. A single year of flooding of longer duration than is currently typical would not appreciably diminish the value of habitat for the survival and recovery of any listed vernal pool plant species. Therefore, this direct effect would be discountable. The WY 2010 Interim Flows would not affect the PCEs of critical habitat for succulent owl's clover, hairy orcutt grass, San Joaquin Valley orcutt grass, Hoover's spurge, Colusa grass, or Greene's tuctoria because it is not likely to adversely affect vernal pools, associated watersheds and hydrologic features, or adjacent upland habitat.

Recovery Plan for Vernal Pool Plant Species. Succulent owl's clover, hairy orcutt grass, San Joaquin Valley orcutt grass, Hoover's spurge, Colusa grass, and Greene's tuctoria are all addressed in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Vernal Pool Recovery Plan) (USFWS 2005). Nearly the entire

Restoration Area, with the exception of Reach 1B, is encompassed within the vernal pool recovery units identified in the Vernal Pool Recovery Plan. The Proposed Action would not interfere with the recovery plan's goals, objectives, strategies, or criteria. Implementing the Proposed Action would not substantially reduce the viability of target species, reduce habitat value or interfere with the management of conserved lands or recovery units, or eliminate opportunities for conservation or recovery actions. Further, it would support the future enhancement and restoration of biological resources along the San Joaquin River. Therefore, implementing the Proposed Action is not likely to adversely affect recovery plans for vernal pool plant species.

Palmate-Bracted Bird's Beak

Palmate-bracted bird's beak has been documented in the vicinity of the Restoration Area near Reach 3 between the San Joaquin River and the Chowchilla Bypass, and also 4 miles south of Reach 2A. Suitable grassland habitat in alkaline soils is present in the Restoration Area and could be affected by Interim Flows. However, Interim Flows would be confined within the existing low-flow channels in areas that are currently subject to periodic flooding. This species is unlikely to be present on alluvial soils in areas that are seasonally inundated or periodically inundated by flood flows along the San Joaquin River. However, potentially suitable habitat may be present along the Eastside Bypass. The Proposed Action includes measures to avoid inundation of potential habitat for palmate-bracted bird's-beak along the Eastside Bypass as described in Section 3.5.2. Therefore, palmate-bracted bird's-beak would not be adversely affected by WY 2010 Interim Flows.

Palmate-bracted bird's beak is pollinated by insects. A survey conducted at the Springtown Alkali Sink in 1993 showed bumblebees to the primary pollinator for this species (USFWS 1998a). No other pollination data are available. With the releasing Interim Flows, water could be conveyed through the summer and fall of WY 2010. This flow duration,would be longer than currently typical in portions of the Restoration Area; however, it is is unlikely to result in a measurable direct effect on vegetation that could support insect pollinators of palmate-bracted bird's beakbecause flows would be restricted to the low-flow channel, which is typically kept clear of such vegetation by the presence of water, regular maintenance of the channel for conveyance, and periodic floods. Therefore, the proposed action is not likely adversely affect insect pollinators.

Critical Habitat for Palmate-Bracted Bird's Beak. No critical habitat has been designated for palmate-bracted bird's beak; therefore, implementing the Proposed Action would not adversely affect critical habitat for this species.

Recovery Plan for Palmate-Bracted Bird's Beak. Palmate-bracted bird's beak is addressed in the *Draft Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a). Implementing the Proposed Action would not interfere with the recovery strategy for this species, which is to maintain self-sustaining populations in protected areas over the species' former range and reintroduce the species in areas where it has been extirpated. No recovery lands have been identified for this species in the Action Area; therefore, implementing the Proposed Action would not adversely affect recovery plans for palmate-bracted bird's beak.

Vernal Pool Invertebrates

Four Federally listed vernal pool invertebrates have potential to be affected by the Proposed Action: Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp. These species are associated with vernal pool and seasonal wetland habitats and are not expected to occur in riverine habitats. Therefore, they are not expected to occur in habitats between the banks or levees of the San Joaquin, Merced, Tuolumne, or Stanislaus rivers. Within the Action Area, they could occur in the Eastside and Mariposa bypasses.

These bypasses were created in uplands that historically contained northern claypan vernal pools. Natural vernal pools have been eliminated from many areas as a result of land conversion for agricultural development, along with the hydrologic modification that resulted when the bypasses and agricultural diversions and discharges were created. However, because of the high clay content of the area’s soils, depressions caused by previous construction activities in upland habitats still tend to hold rainwater for an extended period, so soil and hydrologic conditions may be suitable to support vernal pool invertebrates in some areas.

Mapping conducted by Holland shows vernal pool habitats immediately adjacent to, but not including the Eastside and Mariposa bypasses (Figure 6-1). This data layer is based on aerial images acquired during 1976 to 1995 by DWR’s Land and Water Use Mapping Program. These color images were obtained by aircraft flying at approximately 5,000 feet above the ground surface. Images were reviewed at a scale of 1:10,400, and areas with vernal pools were mapped with a minimum map unit of 40 acres and a minimum of 2 vernal pools. Map units are based on vernal pool density and visible disturbance or fragmentation.

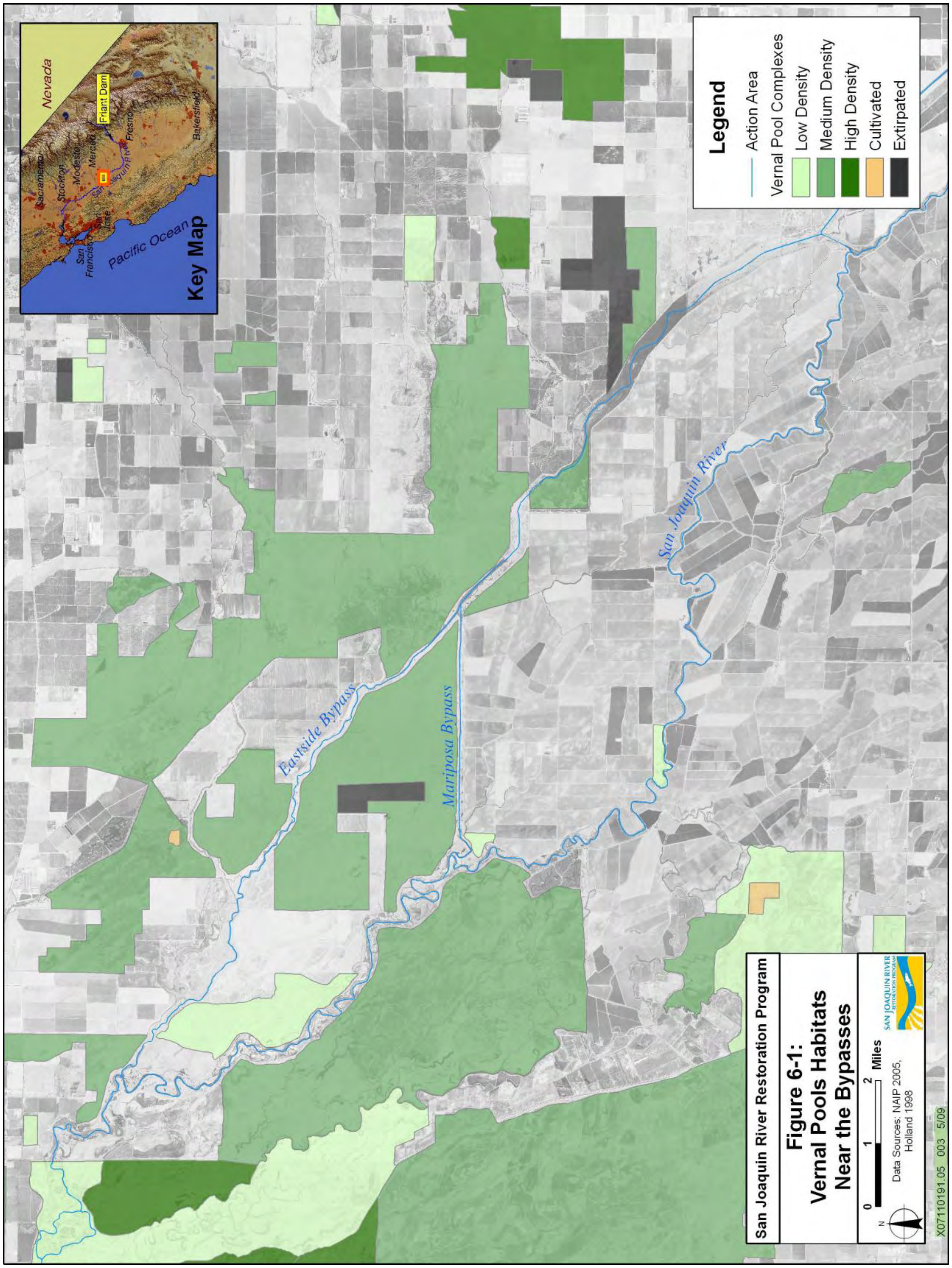
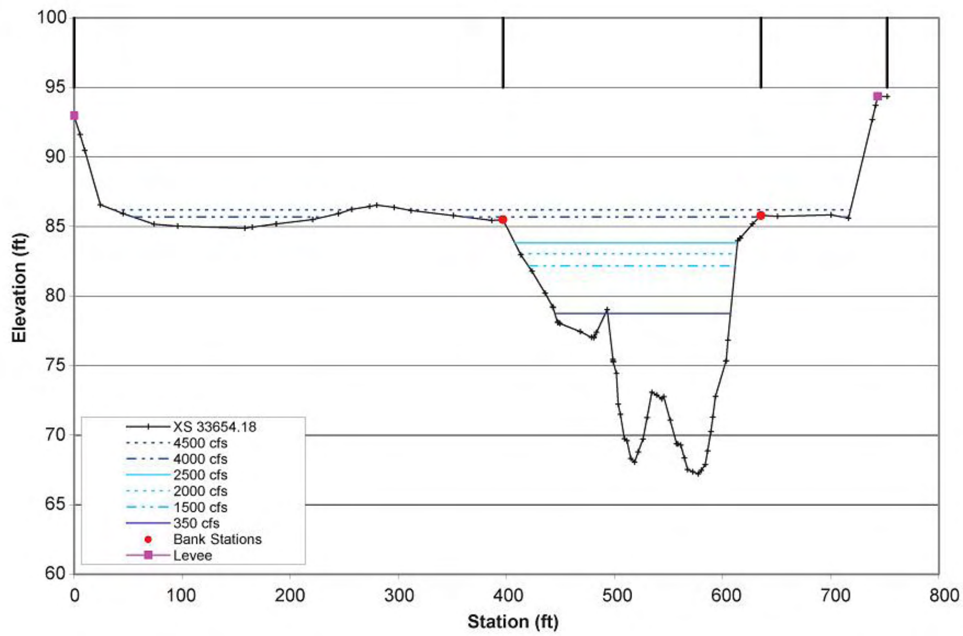


Figure 6-1.
Vernal Pools Habitats near the Bypasses

Baseline conditions within the existing low-flow channel bypasses are unlikely to be suitable for listed vernal pool invertebrates because the channels are regularly inundated during seasonal flood flows. A reconnaissance-level survey of the Eastside Bypass from West Washington Road to Sandy Mush Road was conducted in February and March 2000 (DFG 2000). In February, no evidence of any characteristic vernal pool species was observed in rainwater-filled depressions in the Eastside Bypass, with the exception of early successional invertebrates such as ostracods (seed shrimp) and ceriodaphnid cladocerans (water fleas). Dytiscid larvae and adults (predaceous diving beetles) and exoskeletons of crayfish (*Procambarus* sp.) were also commonly encountered. No vernal pool plant species surrounded the pools; cocklebur was the dominant plant species in these areas. In March, most of the pools observed during the previous survey were completely submerged under a continuous sheet of flowing water, likely the result of flood releases down the San Joaquin River. Large fish such as carp were observed in some of the deeper wetted areas, as well as some adult western toad (*Bufo boreas*). The few isolated pools that remained contained only a few invertebrates, such as Dytiscid larvae. The cladocerans and ostracods that dominated the pools during previous survey were no longer evident.

The WY 2010 Interim Flows would be expected to be confined to the existing low-flow channel in the bypasses and would avoid inundating any seasonal wetland habitat that may be present within the levees. Analysis of inundated surface areas for specific flows from 350 cfs to 8,000 cfs has indicated that maximum Interim Flows of 1,300 cfs in the Eastside Bypass would stay within the existing low-flow channel (Figure 6-2) and would not inundate higher areas within the floodplain (Figure 6-3) (DWR in preparation). As described in Section 3.5.2, “Conservation Measures,” the Proposed Action includes a measure that requires Reclamation to verify that flows would not inundate vernal pool or seasonal wetland habitat to ensure that these habitats would not be affected by the release of WY 2010 Interim Flows.

Based on the low likelihood that suitable habitat for vernal pool invertebrates would be present within the bypass levees, the confinement of WY 2010 Interim Flows to the low-flow channel, and monitoring during releases, the Proposed Action would not result in a measurable adverse effect on Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp.

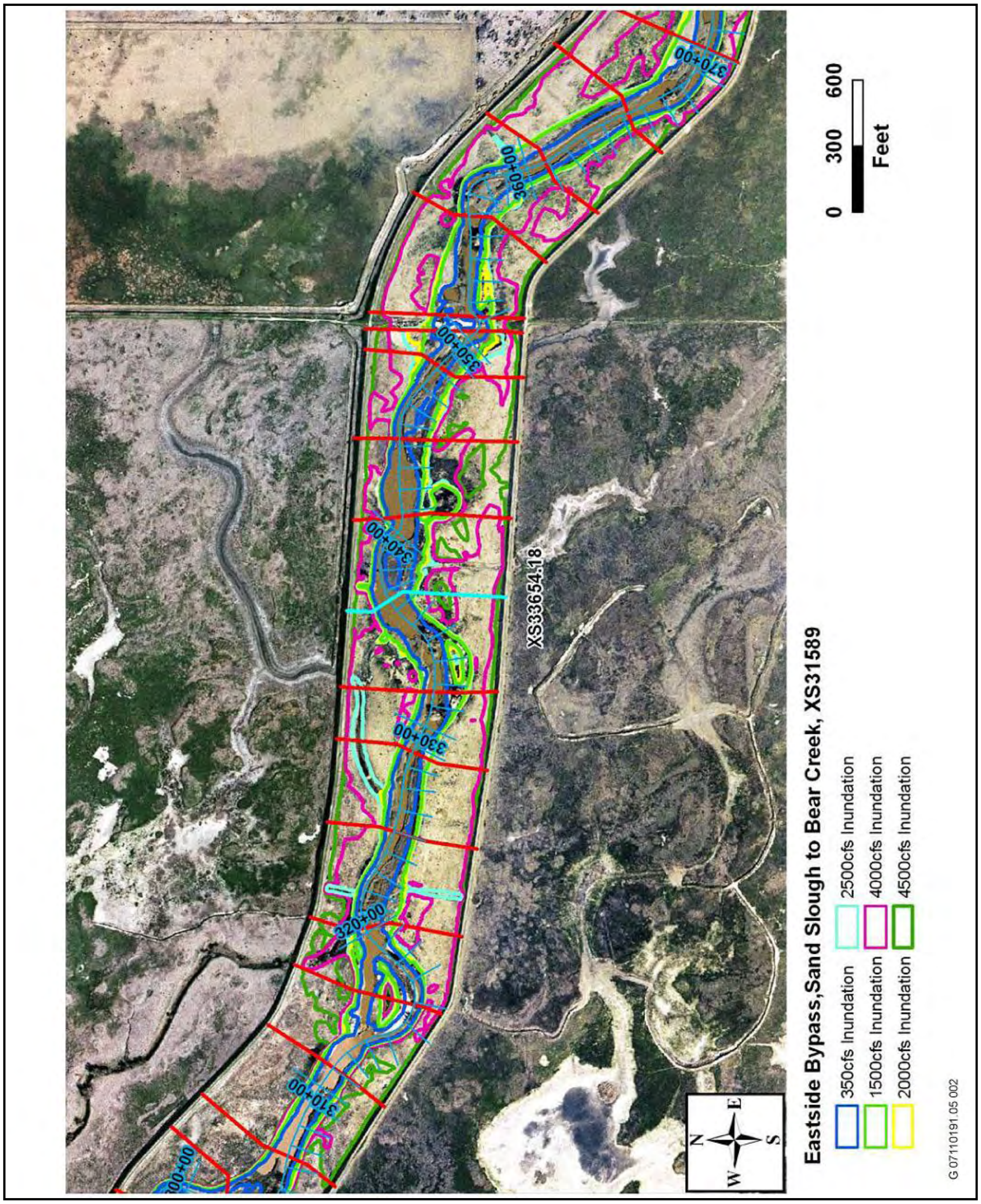


Profile	Equivalent	Elevation
4500	4500	86.21
4000	4000	85.7
2500	2500	83.81
2000	2000	83.04
1500	1500	82.17
350	350	78.76

G 07110191.05 001

Source: DWR in preparation

Figure 6-2.
Typical Cross-Section of Eastside Bypass from Sand Slough to Bear River



Source: DWR in preparation

Figure 6-3.
Water Surface Elevations in Eastside Bypass from Sand Slough to Bear River

Critical Habitat for Vernal Pool Invertebrates. Critical habitat for vernal pool tadpole shrimp, vernal pool fairy shrimp, Conservancy fairy shrimp, and longhorn fairy shrimp has been designated in and adjacent to the Eastside and Mariposa bypasses and San Joaquin River Reaches 4B2 and 5. The critical habitat for vernal pool tadpole shrimp, vernal pool fairy shrimp, and Conservancy fairy shrimp in this area are nearly identical, but critical habitat for longhorn fairy shrimp only is designated south of the San Joaquin River in Reaches 4B2 and 5. Using the published ordinary high water mark of the San Joaquin River and levee boundaries of the bypasses, the maximum amount of critical habitat that could be affected by WY 2010 Interim Flows was calculated (Figure 6-2). However, because the WY 2010 Interim Flows would be confined to the low-flow channel and would not inundate the full width of the levees, this approximation is an over-estimation of the amount of critical habitat that within the action area.

In addition in the Action Area, the designation of critical habitat for Conservancy fairy shrimp includes portions of the Merced River and the designation of critical habitat for vernal pool fairy shrimp includes portions of the Merced and Tuolumne rivers. Although the critical habitat designated for these species extends into the Action Area, suitable vernal pool habitat is not expected to be present within the low-flow channels or active river channels to which WY 2010 Interim Flows would be restricted. The low-flow channel and river channel is also not likely to contain the PCEs of the designated critical habitat for these species, as described above for vernal pool plants.

Table 6-2.
Critical Habitat for Vernal Pool Invertebrates in the Restoration Area

Species	Unit Number	Total Acres in Unit	Location	Maximum Acres Designated Within Action Area[1]	Maximum Percent Within Action Area
Conservancy Fairy Shrimp	7A	3,165	San Joaquin River Reach 4B2 and 5	5	0.1
	7B	1,617	San Joaquin River Reach 4b2 and Eastside Bypass	33	2.1
	7C	6,030	San Joaquin River Reach 4B2 and Eastside and Mariposa Bypasses	501	8.3
	7D	6,911	Eastside Bypass	9	0.1
	6	86,078	Merced River	7	0.01
Longhorn Fairy Shrimp	2	3,165	San Joaquin River Reach 4B2 and 5	5	0.1
Vernal Pool Fairy Shrimp	23A	3,165	San Joaquin River Reach 4B2 and 5	5	0.1
	23B	1,617	San Joaquin River Reach 4b2 and Eastside Bypass	33	2.2
	23C	6,030	San Joaquin River Reach 4B2 and Eastside and Mariposa Bypasses	501	8.3
	23D	6,911	Eastside Bypass	9	0.1
	22	69,139	Merced River	7	0.01
	21B	47,399	Tuolumne River	6	0.01
Vernal Pool Tadpole Shrimp	16A	3,165	San Joaquin River Reach 4B2 and 5	5	0.1
	16B	1,617	San Joaquin River Reach 4b2 and Eastside Bypass	35	2.2
	16C	6,030	San Joaquin River Reach 4B2 and Eastside and Mariposa Bypasses	501	8.3
	16D	6,911	Eastside Bypass	9	0.1

Notes:

[1]Based on the published ordinary high water mark of the San Joaquin, Merced, Tuolumne, and Stanislausrivers and aerial photo interpretation of levee boundaries of Eastside and Mariposa Bypasses. Because WY 2010 Interim Flows would not inundate this entire area (e.g., OHWM of San Joaquin River or bank-full levees in the bypasses), these calculations over-estimate the potential acreage of critical habitat that could be affected. . Furthermore, the low-flow channels of the rivers and bypasses are unlikely to contain the PCEs of the designated critical habitats for the listed vernal pool species.

Recovery Plan for Vernal Pool Invertebrates. Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp are all addressed in the Vernal Pool Recovery Plan (USFWS 2005). Nearly the entire Restoration Area, with the exception of Reach 1B, is encompassed within the vernal pool recovery units identified in the Vernal Pool Recovery Plan. The Proposed Action would not interfere with the Recovery Plan's goals, objectives, strategies, or criteria. Implementing the Proposed Action would not substantially reduce the viability of target species, reduce habitat value or interfere with the management of conserved lands or recovery units, or eliminate opportunities for conservation or recovery actions. Further, it would support the future enhancement and restoration of biological resources along the San Joaquin River. Therefore, implementing the Proposed Action is not likely to adversely affect recovery plans for vernal pool invertebrates.

Valley Elderberry Longhorn Beetle

Blue elderberry shrubs, the host plant for valley elderberry longhorn beetle larvae, are abundant in Reaches 1 and 2 of the San Joaquin River and are sparsely distributed in or absent from Reaches 3, 4, and 5, based on kayak, ground, and aerial surveys conducted in 2004 and 2005 (ESRP 2006). Approximately 410 elderberry shrubs were mapped in Reaches 1 and 2. In Reaches 3, 4, and 5, three elderberry shrubs were observed from the air but could not be located during kayak or ground surveys. Exit holes made by valley elderberry longhorn beetle larvae as they leave the host plant during metamorphosis to the adult stage were found in few shrubs throughout the Restoration Area; less than 1 percent of stems observed had exit holes (ESRP 2006). Elderberry shrubs provide potentially suitable habitat throughout the Restoration Area. Elderberry shrubs grow rapidly, and they may exist in additional areas that have not been surveyed or may have grown in areas since the surveys were conducted. In addition, the beetles could occur in more shrubs; the exit-hole surveys were not comprehensive and results may be outdated.

Because of their locations higher on the streambanks, most elderberry shrubs in the Restoration Area are not expected to be inundated by WY 2010 Interim Flows; however, in San Joaquin River Reach 2A, some elderberry shrubs were noted to be growing along the channel (ESRP 2004, 2006), likely because of altered channel formation and limited flows. Except during times of floods, water passing Gravelly Ford (head of Reach 2A) typically infiltrates the sandy bed before it can reach the Chowchilla Bypass Bifurcation Structure (end of Reach 2A). The few elderberry shrubs in Reach 2 that are growing along the river channel may be partially inundated during a period in spring (up to a maximum of 1,370 to 1,470 cfs). The period of these higher maximum flows would be from mid-March through June, which corresponds to the natural hydrograph of rivers that receive snowmelt from the Sierra Nevada. Elderberry shrubs in Reach 2 are currently subject to temporary flood flows that occur every 2–5 years under existing conditions. Elderberry is a riparian species that can withstand periodic inundation; the WY 2010 Interim Flows would not be likely to result in loss of elderberry shrubs.

It is uncertain how valley elderberry longhorn beetles would respond to inundation of elderberry host plants for a period of up to 14 weeks from mid-March to the end of June (Talley, pers. comm., 2009). Valley elderberry longhorn beetle larvae use the pith of elderberry stems, an environment very low in nutrients (and probably low in oxygen), as a growth chamber until mid-March to June, when adults emerge to feed and reproduce on leaves and flowers of the elderberry shrub. Inundating the lower portions of the elderberry plant, if the plant is not damaged or killed, would not be likely to adversely affect beetle larvae if they were present (Talley, pers. comm., 2009).

In a study on the Cosumnes River, the density of valley elderberry longhorn beetle exit holes was negatively correlated with higher relative bank position (Fremier and Talley 2009). That is, the beetles are more likely to occur in shrubs closer to the river. Although many environmental variables may affect the distribution of valley elderberry longhorn beetle (Fremier and Talley 2009), the proximity to river flows and association with riparian communities are important factors that contribute to the species' presence (Talley, pers. comm., 2009).

The WY 2010 Interim Flows are not likely to result in a measurable direct effect on valley elderberry longhorn beetle because (1) most habitat for the species is outside the area that would be inundated by the flows; (2) the flows would not be of sufficient magnitude to result in scouring or deposition of sediment that could damage elderberry shrubs potentially containing valley elderberry longhorn beetle larvae or pupae; and (3) any larvae or pupae that are present in shrubs that could be temporarily inundated would likely be able to withstand conditions because they are adapted to riparian habitats that are subject to periodic inundation.

Critical Habitat for Valley Elderberry Longhorn Beetle. Critical habitat for valley elderberry longhorn beetle does not occur within the Action Area; therefore, none would be adversely modified as a result of the Proposed Action.

Recovery Plan for Valley Elderberry Longhorn Beetle. USFWS recently completed a 5-year status review for valley elderberry longhorn beetle and recommended delisting the species because of comprehensive riparian habitat restoration projects throughout the range of the species and because surveys have documented that the species is more widespread than thought at the time of listing (USFWS 2006d). At the time of listing, the primary threats to the species were identified as 1) loss of riparian habitat due to flood control, agricultural practices, and park management, and 2) inadequate regulatory mechanisms to protect the species. Surveys have documented valley elderberry longhorn beetle at over 190 locations throughout its range from Shasta County to Fresno County. Los of riparian habitat has slowed in the Central Valley and a number of programs are in place to help protect and restore it (e.g., HCPs, habitat restoration projects on federal, state, and private lands. Efforts specific to valley elderberry longhorn beetle have resulted in the protection of over 50,000 acres of riparian habitat and the restoration of approximately 5,100 acres of beetle habitat (USFWS 2006d).

California Tiger Salamander

California tiger salamander is not expected to be present within riparian areas or stream corridors because this species typically uses vernal pools and seasonal wetlands for breeding and upland grassland habitats for dispersal, foraging, and refuge. The primary historic breeding sites used by California tiger salamanders were vernal pools and other natural seasonal ponds (69 FR 47212). Vernal pools are an important part of the California tiger salamander's breeding habitat in the Central Valley and South San Joaquin regions, but they also use stock ponds in some areas, largely because vernal pool habitat in those areas has been destroyed (69 FR 47212). Riverine habitat is generally unsuitable for California tiger salamanders; therefore, they are not expected to be present in the San Joaquin, Merced, Stanislaus, or Tuolumne rivers and would not be affected by the Proposed Action in these areas.

Portions of the Eastside and Mariposa bypasses in the Action Area were created in uplands that contain vernal pool habitats. California tiger salamanders are known to occur north of the Eastside Bypass in the Merced NWR in floodplain wetlands, slough channels, vernal pools, and artificially created pools adjacent to levees and roads (CNDDB 2009).

As described above for vernal pool plants and invertebrates, the presence of vernal pools or seasonal wetland habitat within the Eastside and Mariposa bypasses has not been confirmed, but these habitats are unlikely to exist within the low-flow channel. The releases of WY 2010 Interim Flows would be restricted to the low-flow channel and would avoid inundating vernal pools and other floodplain habitat that could contain seasonal wetlands. Seepage and vegetation monitoring surveys would be conducted during releases of Interim Flows to determine whether Interim Flows need to be reduced to avoid impacts on these species' habitats. Therefore, flows would not have a measureable direct effect on aquatic habitat for California tiger salamander.

The Proposed Action would also not likely have an adverse effect on upland habitat for California tiger salamander. This species is not likely to use the low-flow channel for upland aestivation or foraging habitat. The presence of water seasonally within the bypass may restrict dispersal of California tiger salamanders under baseline conditions, and the Proposed Action would not substantially change conditions.

Critical Habitat for California Tiger Salamander. Critical habitat for California tiger salamander has been designated on alluvial terraces adjacent to Reach 1A of the San Joaquin River (Unit 1B). Of the 3,003 acres in the unit, 19 acres of critical habitat (0.6 percent of the unit) extend into the river corridor along the north bank of the river. Given that release of the WY 2010 Interim Flows would be confined to the river channel and that riverine habitats are generally unsuitable for California tiger salamander, the Proposed Action is not expected to affect any of the primary constituent elements of critical habitat for this species. Therefore, the Proposed Action would not adversely modify critical habitat for California tiger salamander.

Recovery Plan for California Tiger Salamander. A recovery plan for California tiger salamander has not been developed yet, and recovery goals for this species have not been identified in other recovery plans.

Blunt-Nosed Leopard Lizard

The blunt-nosed leopard lizard is associated with alkali scrub habitat or other sparsely vegetated habitats with sandy soils. Blunt-nosed leopard lizards use the burrows of small rodents for shelter, predator avoidance, and behavioral thermoregulation. They are not expected to be found in riverine or riparian habitats in the Action Area, but could be found in portions of the Eastside and Mariposa bypasses.

The Eastside and Mariposa bypasses cut through upland habitats that could provide suitable habitat for blunt-nosed leopard lizard. They are known to occur adjacent to the Eastside Bypass on the Merced NWR (CNDDB 2009). Under baseline conditions, the Eastside and Mariposa bypasses are periodically inundated by flood flows, which likely reduces the suitability of habitat for blunt-nosed leopards within these areas. However, because flood flows occur seasonally and vary in magnitude between years, some potential exists for blunt-nosed leopard lizard to be present in areas that would be inundated by the WY 2010 Interim Flows if individuals from existing populations outside of the levees moved into the low-flow channel when conditions were dry. If present, some individuals might not be able to escape rising flow waters that could ramp up during spring.

As a conservation measure for the Proposed Action described in Section 3.5.2, “Conservation Measures,” surveys to identify habitat and species presence would be conducted between April 15 and July 15, 2009, when the species is most active. Additional surveys would be conducted between August 1 and September 15, 2009, when hatchlings and subadults are most commonly observed. If surveys document the presence of blunt-nosed leopard lizard in an area that would likely be inundated by WY 2010 Interim Flows, then flows would not be released into the occupied area of the Eastside Bypass. If surveys confirm the presence of blunt-nosed leopard lizard, then WY 2010 Interim Flows may not be released into that area. If an area in the Eastside Bypass presumed to contain suitable habitat for blunt-nosed leopard lizard would likely be inundated by WY 2010 Interim Flows but has not been surveyed, then WY 2010 Interim Flows would not be released into the bypass. Therefore, releasing the WY 2010 Interim Flows would not have a direct adverse effect on blunt-nosed leopard lizard.

Critical Habitat for Blunt-Nosed Leopard Lizard. No critical habitat for blunt-nosed leopard lizard has been designated; therefore, the Proposed Action would not adversely modify critical habitat for this species.

Recovery Plan for Blunt-Nosed Leopard Lizard. Recovery goals for the blunt-nosed leopard lizard are identified in *the Draft Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a). A 5-year status review for blunt-nosed leopard lizard was initiated in 2006, but has not been published. The Proposed Action is unlikely to have an adverse effect on recovery goals for blunt-nosed leopard because the Interim Flows would be limited to 1 year in duration and would not affect an area containing important habitat for the species.

Giant Garter Snake

The giant garter snake has been observed at the San Luis, Kesterson, and West Bear Creek units of the San Luis NWR Complex, in the Mendota Wildlife Area, and at the Mendota Pool (Dickert 2005), and south of the San Joaquin River in Fresno Slough (USFWS 2006b); however, no sightings of giant garter snakes south of the Mendota Wildlife Area have occurred since the time of listing (Hansen 2002). The Restoration Area is located within the San Joaquin Valley Recovery Unit, as described in the draft recovery plan for the species. This species may occur in suitable habitat in other locations in the Action Area. Although it generally avoids large, wide rivers, it may occur in the portions of the San Joaquin River channel that would be inundated by the release of WY 2010 Interim Flows.

The WY 2010 Interim Flows would increase the volume and availability of water in the river channel between early spring and midsummer, which is the active period for this species. Because the giant garter snake requires aquatic habitat for breeding and foraging during spring and summer, the presence of additional flows during these seasons would have a beneficial effect on this species by increasing the availability and reliability of aquatic habitats. Although the increase in water flow could increase water velocities in the river channel, the direct effect on giant garter snake is expected to be negligible because the main channel (reaches 1-5) currently do not provide suitable aquatic habitat due to the lack of summer flows (see table 3-2), with the exception of Mendota Pool at the head of Reach 3. In the Mendota Pool between the San Joaquin River and Mendota Dam, however, velocity would not be substantially altered because, although hydraulically connected, most of the pool lies outside of the route of WY 2010 Interim Flows. Velocities within the pool's backwater on the San Joaquin River would not increase substantially because of the pool's width and volume.

The giant garter snake utilizes uplands adjacent to aquatic features for basking and aestivation. The WY 2010 Interim Flows would not have a measureable direct effect on upland habitats for this species because flows would be restricted to the river channel and immediately adjacent, lower floodplain surfaces and would not inundate upland habitat. Therefore, the potential effects of the WY 2010 Interim Flows on the giant garter snake would be beneficial (increasing available aquatic habitat during the species' active season) or negligible (not resulting in measurable or detectable changes to water velocities in the Mendota Pool or inundating potentially suitable upland habitat).

Critical Habitat for Giant Garter Snake. Critical habitat has not been designated for giant garter snake; therefore, none would be adversely modified as a result of the WY 2010 Interim Flows.

Recovery Plan for Giant Garter Snake. Recovery goals for the giant garter snake are identified in the draft recovery plan for giant garter snake (USFWS 1999a). The WY 2010 Interim Flows are unlikely to have a substantial effect on recovery goals for giant garter snake because the Interim Flows would be limited to 1 year in duration.

Western Yellow-Billed Cuckoo

Most recent records of the western yellow-billed cuckoo are in the Sacramento Valley (Gaines and Laymon 1984). An area near the confluence of the Tuolumne and San Joaquin rivers where a few cuckoos were observed regularly in the late 1960s was subsequently subject to intensive logging, and no cuckoos have been observed in recent years (Reeve, pers. comm., 1998, cited in McBain and Trush 2002). The yellow-billed cuckoo has been considered a rare migratory species during the spring in Stanislaus County (Reeve 1988). This species has potential to nest in suitable habitat in the Restoration Area. It also may occur in suitable habitat in other locations in the Action Area, including along portions of the San Joaquin River channel that would be inundated by the release of WY 2010 Interim Flows.

The nests of western yellow-billed cuckoos would be expected to be well above the waterline during the breeding season (approximately mid-June through mid-August). The WY 2010 Interim Flows could progressively increase nonflood flows during February, March, April, and May throughout the Restoration Area. The potential exists for increased flows to inundate nest sites if they are established before releases, which would result in nest abandonment and the loss of any viable eggs or chicks that have not yet fledged. However, these areas already experience periodic flood flows during spring, and Interim Flows would generally be at nearly their highest levels by March 16 (Table 3-3), before the nesting season of the western yellow-billed cuckoo. Western yellow-billed cuckoos would migrate into the Restoration Area or downstream along the San Joaquin River from late May until late June and would naturally construct their nests above the levels of Interim Flows. Furthermore, the number of nests established below the levels of Interim Flows during the breeding season is expected to be low, given the prevalence of surrounding habitats that are suitable. Therefore, the WY 2010 Interim Flows would not result in any measurable or detectable adverse direct effects on the western yellow-billed cuckoo.

Critical Habitat for Western Yellow-Billed Cuckoo. Critical habitat has not been designated for western yellow-billed cuckoo; therefore, none would be adversely modified as a result of the WY 2010 Interim Flows.

Recovery Plan for Western Yellow-Billed Cuckoo. A recovery plan for western yellow-billed cuckoo has not been developed yet, and recovery goals for this species have not been identified in other recovery plans.

Least Bell's Vireo

By 1980, this species was extirpated from the entire Central Valley, although the species' range is currently expanding northward (RHJV 2004); Least Bell's vireos successfully nested at the San Joaquin River NWR in 2005 and 2006 (USFWS 2006c). The least Bell's vireo nests in dense, low, shrubby vegetation, generally in riparian areas but also brushy fields, young second-growth forest or woodland, scrub oak, coastal chaparral, and mesquite brushlands, where it may build nests as low as 1 foot from the ground. This species may occur in suitable habitat in other locations in the Action Area, including along portions of the San Joaquin River channel that would be inundated by the release of WY 2010 Interim Flows.

Because the Proposed Action would have only a minimal effect on riparian habitats downstream from the Merced River (see discussion above), the WY 2010 Interim Flows would not result in any measurable or detectable adverse affects on the riparian habitats around the San Joaquin NWR or on least Bell's vireos that may be nesting there.

Should this species nest in other riparian areas upstream from the Merced River, its nests would be expected to be well above the waterline during the breeding season (approximately February through August). The WY 2010 Interim Flows could progressively increase nonflood flows during February, March, April, and May throughout the Restoration Area. The potential exists for increased flows to inundate the nest sites of ground and low-vegetation nesters if the sites are established before releases, which would result in nest abandonment and the loss of any viable eggs or chicks that have not yet fledged. However, these areas already experience periodic flood flows during spring, and Interim Flows would generally be at nearly their highest levels by March 16 (Table 3-3), before the nesting season of the least Bell's vireo. The least Bell's vireo would migrate into the Restoration Area or downstream along the San Joaquin River in mid- to late April and would naturally construct its nests above the levels of Interim Flows. Furthermore, the number of nests established below the levels of Interim Flows during the breeding season is expected to be low, given the prevalence of surrounding habitats that are suitable. Therefore, the WY 2010 Interim Flows would not result in any measurable or detectable adverse direct effects on the least Bell's vireo.

Critical Habitat for Least Bell's Vireo. Critical habitat has been designated for least Bell's vireo; however, because the critical habitat is not located within the Action Area, none would be adversely modified as a result of the WY 2010 Interim Flows.

Recovery Plan for Least Bell's Vireo. A draft recovery plan for Least Bell's Vireo has been prepared (USFWS 1998b). The plan does not identify recovery goals specific to the Action Area. However, it does identify a goal of protecting and managing riparian habitats within the species' historical range. The Proposed Action is unlikely to have a substantial effect on recovery goals for least Bell's vireo because the WY 2010 Interim Flows would be limited to 1 year in duration.

Riparian Brush Rabbit

The riparian brush rabbit has very limited distribution along the lower portions of the San Joaquin and Stanislaus rivers. Recent captive breeding and recovery efforts have included establishing one population in 2002 in restored habitat on the San Joaquin River NWR and releasing another small population in 2005 on private lands adjacent to the San Joaquin River NWR, west of Modesto. Other known populations are from Caswell Memorial State Park near Ripon, and in Paradise Cut and along the San Joaquin River west of Manteca. Riparian brush rabbits are not expected to occur upstream from the confluence with the Merced River. Because the WY 2010 Interim Flows would have only a minimal effect on riparian habitats downstream from the Merced River (see discussion above), the Proposed Action would not result in any measurable or detectable adverse direct effects on the riparian brush rabbit.

Critical Habitat for Riparian Brush Rabbit. Critical habitat has not been designated for riparian brush rabbit; therefore, none would be adversely modified as a result of the WY 2010 Interim Flows.

Recovery Plan for Riparian Brush Rabbit. Recovery goals for the riparian brush rabbit are identified in the *Draft Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a). The Proposed Action is unlikely to have a substantial effect on recovery goals for riparian brush rabbit because the Interim Flows would be limited to 1 year in duration.

San Joaquin (Riparian) Woodrat

Although the San Joaquin Valley (or riparian) woodrat was historically found along the San Joaquin, Stanislaus, and Tuolumne rivers and likely occurred throughout the riparian forests of the northern San Joaquin Valley, no occurrences of San Joaquin Valley woodrat have been documented within or in the vicinity of the Action Area. San Joaquin Valley woodrat builds stick houses in dense riparian vegetation at the base of trees or in tree cavities and canopies. Potentially suitable habitat for San Joaquin Valley woodrat exists in riparian vegetation that would be inundated by WY 2010 Interim Flows. However, because the only verified extant population of San Joaquin Valley woodrat is located on the Stanislaus River at Caswell Memorial State Park (USFWS 1998a), which is outside the Action Area, the WY 2010 Interim Flows would not result in any adverse direct effects on this species.

Critical Habitat for San Joaquin Valley Woodrat. Critical habitat has not been designated for San Joaquin Valley woodrat; therefore, none would be adversely modified as a result of the WY 2010 Interim Flows.

Recovery Plan for San Joaquin Valley Woodrat. Recovery goals for the San Joaquin Valley woodrat are identified in the *Draft Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998b). The Proposed Action is unlikely to have a substantial effect on recovery goals for San Joaquin Valley woodrat because the Interim Flows would be limited to 1 year in duration.

Fresno Kangaroo Rat

The Fresno kangaroo rat has been reported in the vicinity of the Restoration Area, having been observed at the Alkali Sink Ecological Reserve and Mendota Wildlife Management Area. However, this species is considered by some to be extirpated along the San Joaquin River because of repeated negative findings during survey efforts since 1993 (DFG 2005). Flooding of habitat by the San Joaquin River has been considered a potential threat to this species; however, the Fresno kangaroo rat generally does not occupy riparian areas, although it may disperse through dry river washes. Further, this species tends to have a small home range and is not expected to regularly disperse across the river channel. Suitable upland habitats and occupied burrows may be located adjacent to the Action Area; however, this species would not be affected along any reach or bypass because the WY 2010 Interim Flows would be restricted to the river channel and lower floodplain surfaces. Therefore, the Proposed Action would not result in any adverse direct effects on this species given that its optimal habitat is located outside of the low-flow channel, which would be inundated by the WY 2010 Interim Flows.

Critical Habitat for Fresno Kangaroo Rat. Critical habitat has been designated for Fresno kangaroo rat; however, because this critical habitat is not located within the Action Area, none would be adversely modified as a result of the WY 2010 Interim Flows.

Recovery Plan for Fresno Kangaroo Rat. Recovery goals for Fresno kangaroo rat are identified in the *Draft Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a). The Proposed Action is unlikely to have a substantial effect on recovery goals for Fresno kangaroo rat because the WY 2010 Interim Flows would be restricted to the river channels.

San Joaquin Kit Fox

San Joaquin kit fox is not expected to occur in riparian or riverine habitats that encompass most of the Action Area. This species prefers open grassland or scrub habitats and creates burrows for denning and refuge. Although occupied dens may be located near the river corridor, they would not be affected along any reach by the release of Interim Flows. Water from the flow releases would be restricted to the low-flow channel and adjacent lower floodplain surfaces, which are characterized by open water, riverwash, emergent wetland, and riparian scrub and forest. These habitats are not suitable for denning. The Eastside and Mariposa bypasses may provide suitable upland habitat used for foraging and dispersal. Implementing the Proposed Action would not affect the ability of San Joaquin kit fox to carry out these activities, because the species is mobile and wide ranging and often uses road crossings and culverts to traverse aquatic features. Because the WY 2010 Interim Flows are not expected to inundate dens, or restrict movement of San Joaquin kit fox, the Proposed Action would not result in any adverse direct effects on the species.

Critical Habitat for San Joaquin Kit Fox. Critical habitat has not been designated for San Joaquin kit fox; therefore, none would be adversely modified as a result of the WY 2010 Interim Flows.

Recovery Plan for San Joaquin Kit Fox. Recovery goals for San Joaquin kit fox are identified in the *Draft Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998a). The Action Area includes areas identified as important to the recovery of the species. The WY 2010 Interim Flows is unlikely to have a substantial effect on recovery goals for San Joaquin kit fox because the Interim Flows would be restricted to the river channels, which are seasonally inundated under existing conditions and are unlikely to provide important habitat for the species.

6.2 Interrelated and Interdependent Effects

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification (50 Code of Federal Regulations 402.02). Interdependent actions are those that have no significant independent utility apart from the action that is under consultation. Interrelated and interdependent actions are activities that would not occur “but for” the WY 2010 Interim Flows.

The joint USFWS/NMFS ESA Handbook explains (on page 4-27) how an existing dam is considered as part of the baseline when USFWS and NMFS consult on a later, related action and conclude that a preexisting dam has independent utility (USFWS and NMFS 1998), and therefore is not interrelated to or interdependent with the Proposed Action. Ongoing effects of the existing dam are already included in the environmental baseline and would not be considered an effect of the Proposed Action under consultation. Thus, if a dam can exist independent of the Proposed Action, the operation of the dam is not interrelated or interdependent and effects of the dam are not considered as part of the effects of the Proposed Action under consultation, but as part of the environmental baseline.

Interrelated effects of implementing the WY 2010 Interim Flows include a negligible increase in Delta inflow from the San Joaquin River and correspondingly negligible increase in exports at the Jones and Banks facilities. The Jones and Banks export facilities are located in the south Delta and are connected by Old and Middle rivers to the San Joaquin River near where it enters the Delta. When the export pumps are not operating, flows in Old and Middle rivers move from the upstream reaches that join the San Joaquin River in the southeastern Delta to the downstream reaches that join the lower portion of the river. However, when the pumps are operating, they often export such large volumes of water that flow in the downstream portions of Old and Middle rivers moves upstream toward the pumps.

The USFWS 2008 OCAP BO for delta smelt restricts reverse flows in the Old and Middle river channels downstream (and north) of the export facilities. To meet water management objectives of WY 2010 Interim Flows, the increased Delta inflow from the San Joaquin River would lead to increased Delta export pumping when pumping could occur within regulatory constraints such as the USFWS 2008 OCAP BO for delta smelt. This increased export pumping would have little effect on Old and Middle river flows but would increase flow in the upstream portions of Old and Middle rivers and other channels leading from the San Joaquin River to the export facilities. A substantial portion of the increased San Joaquin River inflow would likely not be recirculated, resulting in increased flow in the San Joaquin River through the Delta.

Old and Middle river flow would rarely, if at all, be affected by the WY 2010 Interim Flows because of the new reverse-flow restrictions required under the 2008 OCAP BO. Surveys of adult delta smelt during their spawning migrations rarely find the adults upstream from where Old and Middle rivers join the downstream portion of the San Joaquin River (http://www.delta.dfg.ca.gov/data/skt/DisplayMaps.asp), so the increased flows toward the pumps in the upstream channels of the Delta would likely have little effect on delta smelt. Increased flow in the lower portion of the San Joaquin River would likely benefit the smelt during their upstream and downstream migrations by providing stronger environmental cues and transport flows, resulting in less straying of the fish into the south Delta.

Implementing the WY 2010 Interim Flows may increase diversions by a small percentage at the Jones and Banks export facilities. The increased diversions may affect entrainment of delta smelt close to the facilities or in channels with flows moving toward the pumps. However, delta smelt rarely occur in the southeastern Delta. In addition, the increased flows in the lower Delta portion of the San Joaquin River expected to occur under WY 2010 Interim Flows would likely reduce the straying of delta smelt toward the south Delta or the export facilities. Although the risk of entrainment for delta smelt in the south Delta would be increased because of the slight increases in exports, the risk of smelt occurring at these locations would be reduced because of the higher San Joaquin River flows. Therefore, implementing the WY 2010 Interim Flows is anticipated to have no net effect on delta smelt entrainment. Furthermore, the regulatory requirements embodied in the USFWS 2008 OCAP BO for delta smelt would remain in effect during WY 2010 and would be applicable to the WY 2010 Interim Flows project. These regulatory requirements would ensure that allowable take limits at the Delta export facilities would not be exceeded.

Flow from the San Joaquin River towards the pumps are expected in the upstream section of Old and Middle rivers, where the emigrating steelhead are at risk, but not in the downstream section of Old and Middle rivers north of the pumps, where delta smelt and other sensitive species would be at risk. The 2008 OCAP BO for delta smelt places restrictions on reverse flows in the Old and Middle river sections. Therefore, the potential increase in export pumping, would have little effect on Old and Middle river flows but would increase flow in the upstream portions of Old and Middle rivers and other channels leading from the San Joaquin River to the export facilities.

Because the CVP and SWP operations, including export activities, affect fish and wildlife in the Central Valley, Reclamation consulted with both USFWS and NMFS under Section 7 of the ESA. The most recent consultation has been completed with USFWS for delta smelt (BO published in 2008). NMFS is currently preparing their BO for Sacramento River winter-run Chinook salmon ESU, Central Valley spring-run Chinook salmon ESU, Central Valley steelhead DPS, and North American green sturgeon, with the expected release date in June 2009. Therefore, any adverse effects from increased pumping would be limited by regulatory restrictions included in the pending NMFS OCAP BO. The WY 2010 Interim Flows would not increase take above acceptable limits established by the NMFS OCAP BO for Banks and Jones pumping plants. Therefore, the Proposed Action is not likely to adversely affect Central Valley steelhead.

6.2.1 EFH

The WY 2010 Interim Flows include an increase in exports at the Jones and Banks facilities in the south Delta to recirculate some of the increased flow provided for the WY 2010 Interim Flows. The WY 2010 Interim Flows also include an increase in San Joaquin River inflow, which would increase flow in the river through the Delta.

As described for delta smelt above, the increased inflows are expected to reduce the straying of starry flounder into the south Delta, and the increase in exports may increase entrainment but the regulatory requirements embodied in the USFWS 2008 OCAP BO for delta smelt would remain in effect during WY 2010 and would be applicable to the WY 2010 Interim Flows project. These regulatory requirements would ensure that allowable take limits at the Delta export facilities would not be exceeded, which would also provide additional protection for starry flounder. These two effects are expected to offset one another, resulting in no net effect on starry flounder EFH.

As described above, protective measures anticipated in the NMFS BO would protect Pacific salmon. Therefore, there would be no effect on Pacific salmon EFH.

6.3 Cumulative Effects

Cumulative effects, as defined under Section 7 of the ESA and implementing regulations, include the effects of future State, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions, including other SJRRP actions, are not addressed as cumulative effects under Section 7 of the ESA. For each listed species, this section addresses the additive impact of the Proposed Action and all foreseeable, non-Federal, future actions. These impacts are addressed separately for fisheries and for terrestrial plants and wildlife.

6.3.1 Methodology and Approach

For purposes of assessing cumulative effects, the Action Area consists of all areas directly or indirectly affected by the Federal action (USFWS and NMFS 1998). Listed fish species would be affected by WY 2010 Interim Flows throughout the Action Area defined in Section 1.3, “Action Area.” Listed terrestrial plants and wildlife, however, would be affected only within the Restoration Area (i.e., those reaches of the San Joaquin River and flood bypasses between Friant Dam and the Merced River that would receive WY 2010 Interim Flows).

Several actions are ongoing or planned in the Restoration Area and elsewhere in the Action Area. These actions include water resource projects, resource management plans and programs, and development projects (see Appendix C for a detailed description). Most of these projects, however, are likely to involve Federal funding and/or permitting, and are therefore not considered cumulative under the ESA. However, some of these actions may not involve Federal funding and/or permitting (e.g., some private development and some management activities). Also, an undetermined number of future actions could go forward without a Section 404 permit to fill wetlands, an incidental-take permit through Section 10 of the ESA, or other Federal action. Future State or private actions that could potentially affect listed species include actions that affect or result in any of the following:

- Habitat conversion or fragmentation.
- Herbicide or pesticide applications.
- Vegetation management, including along waterways,
- Grazing practices,
- Crop selection (including crop types cultivated, fallowing or idling of cropland, and abandonment of agricultural land),
- Ground-disturbing activities (including ripping of soils),
- Discharge of contaminants into waterways,

- Presence of humans along waterways on agricultural lands, or in natural vegetation,
- Predator abundance (e.g., coyotes),
- Dispersal and establishment of invasive species,
- Flow regimes of waterways,
- Use of off-road vehicles and traffic levels on local roads.

All of these activities and scenarios can degrade habitat or cause the injury or death of listed species. These activities regularly change in response to market conditions and new technologies. For some of these activities (such as some agricultural practices), attempting to predict future changes and their consequences for listed species would be speculation. Nonetheless, the vulnerability of listed species to different types of actions varies, many actions are associated with particular land uses or management practices, and the distribution of potential habitat with regard to existing and planned land uses is known. Therefore, this analysis uses these known relationships between types of non-Federal actions and effects on species, and among habitats, non-Federal actions, and land use, as the primary basis for evaluating the cumulative effects of foreseeable future actions.

Data sources for this analysis included existing and available information summarized in the environmental baseline and species accounts (see Chapters 4 and 5), and review of land use designations of applicable general plans, land ownership, and Williamson Act contract data.

6.3.2 Cumulative Effects on Fisheries

Fish could be affected by projects that could result in disruption of stream banks or degradation of water quality through herbicide or pesticide applications; vegetation management along waterways; grazing practices, and ground-disturbing activities.

The success of fish populations has been linked to levels of turbidity and siltation in a watershed. Prolonged exposure to high levels of suspended sediment can create a loss of visual capability, leading to a reduction in feeding and growth rates; a thickening of the gill epithelium, potentially causing the loss of respiratory function; a clogging and abrasion of gill filaments; and increases in stress levels, reducing the tolerance of fish to disease and toxicants (Waters 1995).

Also, high suspended sediment levels will cause the movement and redistribution of fish populations and can affect physical habitat. Once the suspended sediment is deposited, it can reduce water depths in pools, decreasing the water’s physical carrying capacity for juvenile and adult fish (Waters 1995). Increased sediment loading can also degrade food-producing habitat downstream of the project area. Sediment loading can interfere with photosynthesis of aquatic flora and result in the displacement of aquatic fauna.

Many fish, including juvenile salmonids, are sight feeders. Turbid waters reduce the fish's efficiency in locating and feeding on prey. Some fish, particularly juveniles, can get disoriented and leave areas where their main food sources are located, which can result in reduced growth rates.

Avoidance is the most common result of increases in turbidity and sedimentation. Fish will not occupy areas that are not suitable for survival, unless they have no other option. Therefore, habitat can become limiting in systems where high turbidity precludes a species from occupying habitat required for specific life stages.

Additional cumulative effects may result from exposures to contaminants in discharges from point and nonpoint sources. These contaminants include selenium and numerous pesticides and herbicides associated with discharges related to agricultural and urban activities. Contaminants may injure or kill salmonids by affecting food availability, growth rate, susceptibility to disease, or other physiological processes necessary for survival. Laboratory studies show that sublethal concentrations of pesticides can affect many aspects of salmon biology, including a number of behavioral effects such as avoidance, delayed migration, and increased stress rendering them more susceptible to predation (http://www.krisweb.com/stream/pesticide_fisheffects.htm).

6.3.3 Cumulative Effects on Terrestrial Plants and Wildlife

Vernal Pool Plant Species

Plant species occurring in vernal pool landscapes in or near the Restoration Area include succulent owl's clover, Colusa grass, San Joaquin Valley Orcutt grass, and hairy Orcutt grass. In and near the Restoration Area, vernal pool landscapes have been eliminated or fragmented by conversion to agricultural and developed uses, and remaining vernal pools have been degraded by the activities associated with these uses (e.g., alteration of hydrology, deep ripping of soils). Also, invasive plant species (e.g., nonnative annual grasses) have become abundant in most vernal pool landscapes and degraded their habitat value for native species.

Vernal pool landscapes remain near the Restoration Area north and south of San Joaquin River Reach 1A, in and near the Restoration Area along Reaches 4B and 5, and along the bypasses. Land near Reach 1A is in a mix of natural vegetation, cropland, and developed land uses. The remaining vernal pool landscapes are primarily in private ownership, and are designated in general plans for developed uses or open space; only a small portion of the land is under Williamson Act contracts. Along the bypasses, land is in natural vegetation or cropland, with the natural vegetation concentrated in a corridor along the flood bypass itself. General plans designate this land for agricultural uses or open space. Most remaining vernal pool landscapes are on public lands managed to sustain biodiversity (e.g., Grasslands Wildlife Management Area), and a substantial portion of the privately owned land is under Williamson Act contracts. Along Reaches 4B and 5 of the San Joaquin River, most remaining vernal pool complexes are on public land managed to sustain biodiversity (e.g., the San Luis NWR) and most privately owned land is under Williamson Act contracts. General plans designate all of these lands for agricultural uses.

Climate change and the spread of invasive species will affect all remaining vernal pool landscapes. However, other cumulative effects are not likely to eliminate or degrade vernal pool habitats, or to otherwise reduce the viability of populations of vernal pool plant species, along the bypasses or Reaches 4B and 5, because most remaining vernal pool landscapes in these areas are on public land managed by USFWS, DFG, or the California Department of Parks and Recreation.

Near Reach 1A of the San Joaquin River, however, non-Federal actions are likely to result in additional loss and degradation of vernal pool landscapes. Because of the mosaic of developed land uses, cropland, and natural vegetation in this area, the remaining vernal pool landscapes are already fragmented and experiencing degradation resulting from human activities such as off-road vehicle use, agricultural activities, and altered hydrology. Because population growth and additional conversion of natural vegetation to cropland or developed uses is likely to occur (particularly in areas already designated for developed land uses), additional loss, fragmentation, and degradation of vernal pool landscapes is likely near Reach 1A. These impacts may be substantial and may reduce the viability of vernal pool plant species in this area.

The Proposed Action would not contribute to these cumulative effects: Vernal pools have not been documented along the San Joaquin River or bypasses in areas seasonally inundated by river flows, and inundation of vernal pools would be avoided during implementation of WY 2010 Interim Flows. WY 2010 Interim Flows also would not alter agricultural practices potentially affecting vernal pool plant species in the Restoration Area or involve construction activities that may adversely affect vernal pool species.

Critical Habitat for Vernal Pool Plant Species

The cumulative effects on critical habitat for vernal pool plant species would be the same as the effects on vernal pool plants described previously. Critical habitat for hairy Orcutt grass, San Joaquin Orcutt grass, and succulent owl’s clover has been designated in the Restoration Area north of San Joaquin River Reach 1A, which is the area previously described as likely to experience additional loss, fragmentation, and degradation of vernal pool landscapes. Critical habitat for Colusa grass and Hoover’s spurge has been designated in Reach 4B and along the Eastside and Mariposa bypasses, which is the area previously described as experiencing little or no loss, fragmentation, or degradation as cumulative effects of non-Federal present and future actions. The WY 2010 Interim Flows would not affect the primary constituent elements of these critical habitats and thus would not contribute to cumulative effects.

Palmate-Bracted Bird’s-Beak

Palmate-bracted bird’s-beak grows in alkaline soils in scrub and grassland vegetation. In the Restoration Area, suitable habitat for this species has been substantially reduced, fragmented, and degraded by conversion of natural vegetation to agricultural and developed land uses, and by the activities associated with those land uses that affect remaining natural vegetation (e.g., uses of off-road vehicles and alterations to hydrology). Currently, the major threats to palmate-bracted bird’s-beak are loss or degradation of habitat from incompatible grazing practices, hydrological alternations, use of off-road vehicles, and conversion to agricultural and developed uses. Also, potential impacts from climate change are not well understood but could be considerable.

Palmate-bracted bird's-beak has been documented near the Restoration Area south of San Joaquin River Reach 2A and between the river and the Chowchilla Bypass; therefore, occupied or potentially suitable habitat may exist in the Restoration Area in Reaches 2A or 3, the Chowchilla Bypass, or possibly the upstream segment of the Eastside Bypass. In addition, alkali sink habitat exists south of the Restoration Area in the North Grasslands Wildlife Area. Land along San Joaquin River Reaches 2A and 3 and the bypasses is primarily privately owned, in agricultural use, and designated in general plans for agricultural use, and is also primarily under Williamson Act contracts. The main exception is land designated for developed land uses in Firebaugh in Reach 3; almost all of this land, however, is already in developed or agricultural use.

Therefore, additional conversion of habitat to urban land uses and an increase in activities associated with urbanization and increased population may not affect palmate-bracted bird's-beak in the Restoration Area. Rather, the primary future actions affecting palmate-bracted bird's-beak are related to agricultural activities. Agricultural activities potentially affecting this species, its pollinators, or their habitat include changes in grazing practices, use of off-road vehicles, herbicide use, and conversion of natural vegetation to row or field crops. Most (and possibly all) potential habitat in these portions of the Restoration Area is not managed to sustain biodiversity, and several agricultural activities could eliminate or degrade habitat; therefore, some additional loss or degradation of palmate-bracted bird's beak habitat is likely.

Occupied or potentially suitable habitat for palmate-bracted bird's beak habitat has not been documented along the San Joaquin River or bypasses in areas seasonally inundated by river flows, and inundation of potentially suitable habitat would be avoided during implementation of WY 2010 Interim Flows. Therefore, the Proposed Action would not contribute to cumulative effects on this species. Interim Flows also would not alter agricultural practices potentially affecting palmate-bracted bird's-beak in the Restoration Area.

Vernal Pool Invertebrates

Vernal pool invertebrates present in vernal pool landscapes in and near the Restoration Area include Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool tadpole shrimp, and vernal pool tadpole shrimp. Cumulative effects on vernal pool landscapes in and near the Restoration Area were described previously (see "Vernal Pool Plant Species" above). Vernal pool invertebrates would also experience those cumulative effects. Vernal pool landscapes north of Reach 1A of the Restoration Area would likely experience additional loss, fragmentation, and degradation. Vernal pool landscapes in Reach 4B and along the Eastside and Mariposa bypasses are likely to experience little or no loss, fragmentation, or degradation as cumulative effects of present and future non-Federal actions. The Proposed Action would not affect vernal pool landscapes and thus would not contribute to these cumulative effects.

Critical Habitat for Vernal Pool Invertebrates

The effects on critical habitat for vernal pool plant species would be the same as the effects on vernal pool plants described previously. Critical habitat for vernal pool fairy shrimp has been designated in the Restoration Area north of San Joaquin River Reach 1A. These vernal pool landscapes are likely to experience additional loss, fragmentation, and degradation. Critical habitat for Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool tadpole shrimp, and vernal pool tadpole shrimp has been designated in Reaches 4B and 5 of the San Joaquin River and along the Eastside and Mariposa bypasses. These vernal pool landscapes are likely to experience little or no loss, fragmentation, or degradation as cumulative effects of non-Federal present and future actions. The Proposed Action would not affect the primary constituent elements of these critical habitats and thus would not contribute to these cumulative effects.

Valley Elderberry Longhorn Beetle

Valley elderberry longhorn beetle is only found in association with its host plants, the elderberry shrub (*Sambucus* sp.), which grows in riparian vegetation. This species is threatened by habitat loss and by predation and displacement by the invasive Argentine ant.

The extent of valley elderberry longhorn beetle habitat has been substantially reduced throughout its range, including the Restoration Area. The San Joaquin River has changed dramatically since the early part of the 19th century. The river is now largely confined within constructed levees and bounded by agricultural and urban development, flows are regulated through dams and water diversions, and floodplain habitats have been fragmented and reduced in size and diversity (McBain and Trush 2002). As a result, the riparian communities and associated wildlife have substantially changed from historic conditions (Jones and Stokes 1998). The presence of Friant Dam reduces the frequency of scouring flows, which has resulted in a gradual decline of bare gravel and sandbar surfaces. Over time, the vegetation succession of riparian scrub to forest is no longer balanced by periodic loss of forest to the river caused by erosion and appearance of new riparian scrub on sand and gravel bars. In addition, operation of Friant Dam has caused the loss of gradually declining flows in spring, which are periodically necessary to disperse willow and cottonwood seeds and establish seedlings of these riparian tree and shrub species. Drought conditions caused by diversions have also caused riparian vegetation to be lost in several reaches of the river (e.g., Reaches 2 and 4A), and urban and agricultural development have caused a gradual loss of area available for riparian habitat (Jones and Stokes 1998).

In the Restoration Area, the remaining riparian vegetation is primarily in narrow corridors, which consist mainly of shrub-dominated scrubs, but also include narrow bands and some wider patches of riparian forest along all reaches of the San Joaquin River. In the bypass system, riparian vegetation consists of discontinuous narrow corridors and patches. Within the remaining riparian vegetation of the Restoration Area, elderberry shrubs are widespread in Reaches 1 and 2, and very sparsely distributed in Reaches 3, 4, and 5; their presence in the bypass system has not been documented.

The primary factors affecting the extent of native riparian vegetation (including elderberry shrubs) within the Restoration Area are (1) availability of sufficient surface water and groundwater to support plant establishment, growth, and survival; (2) spread of invasive, nonnative plants that displace native riparian vegetation; (3) disturbances that remove established riparian vegetation (e.g., levee maintenance activities, fires); and (4) adjacent land uses that constrain the maximum extent of riparian vegetation and are often the sources of invasive species and disturbances.

Non-Federal actions would affect some of these limiting factors, and their cumulative effects would differ among river reaches and bypasses. The availability of surface water and groundwater along the San Joaquin River is not anticipated to change substantially as a result of non-Federal actions. Invasive plants, however, are anticipated to continue to spread downstream. In Reach 1A, red sesbania and several other invasive species are already widespread and have displaced large areas of native vegetation. These species would likely become more abundant downstream, displacing native vegetation within remaining riparian areas (and resulting in a net replacement of native herbaceous and tree-dominated riparian vegetation with nonnative shrub-dominated vegetation). In addition, valley elderberry longhorn beetle could be affected by additional spread of Argentine ants within riparian vegetation in the Restoration Area; however, the current distribution and ongoing spread of Argentine ants in the Restoration Area is not known.

In the absence of changes to adjacent land uses or management of the river corridor, the frequency and effects of disturbances removing riparian vegetation would remain similar to existing conditions. However, non-Federal actions are likely to change land uses and management of the river corridor along Reach 1A. Much of the land in and adjacent to the Restoration Area in Reach 1A of the San Joaquin River is privately owned and designated for developed land uses, but is currently cropland or natural vegetation; these changes would likely increase the disturbance of riparian vegetation along Reach 1A. Along Reaches 1B–5, changes in land use would be more limited because most private land adjacent to the river corridor is cropland, designated in general plans for agricultural use, and under Williamson Act contracts. Also, along Reaches 4B and 5, a substantial portion of adjacent land is Federally or State owned and managed to sustain biodiversity. However, some land use changes could still occur along Reaches 1B–5, particularly the conversion of remaining natural vegetation on private land to cropland.

The cumulative effect of non-Federal actions would likely be a reduction in the extent and quality of valley elderberry longhorn beetle habitat, and this could reduce the valley elderberry longhorn beetle population within the Restoration Area. The Proposed Action would not increase these cumulative effects. WY 2010 Interim Flows may increase plant establishment or mortality at some locations, but these flows are unlikely to substantially alter the extent of existing riparian vegetation. Most elderberry shrubs are not anticipated to be inundated by WY 2010 Interim Flows, and these flows are not likely to result in loss of elderberry shrubs or any resident beetles. However, the invasive plant management included in the WY 2010 Interim Flows would limit the spread of these species for several years.

California Tiger Salamander

California tiger salamander is associated with vernal pool landscapes, and has been documented in vernal pool landscapes in the San Luis NWR and at Great Valley Grasslands State Park. It is threatened by the introduction of exotic predators (e.g., bullfrogs and mosquitofish), fragmentation of habitat, vehicle-related mortality, and rodent-control programs that result in loss of aestivation habitat.

Cumulative effects on California tiger salamander would be similar to those described previously for vernal pool plants. However, California tiger salamander would experience greater adverse effects from habitat fragmentation, and human activities in adjacent areas, because of its dispersal and seasonal movements. Like vernal pool plant species, and for the same reasons given previously, California tiger salamander would likely experience habitat loss and degradation and reduced population viability in vernal pool landscapes north and south of Reach 1A. However, except for the effects of climate change and the continued spread of invasive plants, cumulative effects are not likely to eliminate or degrade vernal pool habitats, or otherwise affect California tiger salamander along the bypasses or Reaches 4B and 5. The WY 2010 Interim Flows would not affect vernal pool landscapes, and thus it would not contribute to these cumulative effects.

Critical Habitat for California Tiger Salamander

Critical habitat for California tiger salamander abuts the Restoration Area on either side in San Joaquin River Reach 1A, and exists within the Restoration Area at one location along Reach 1A. The cumulative effects on California tiger salamander critical habitat would be the same as those described previously for California tiger salamander in vernal pool landscapes along Reach 1A. The Proposed Action would not contribute to these cumulative effects because it would not affect vernal pool landscapes, and thus would not affect the primary constituent elements of critical habitat for California tiger salamander.

Blunt-Nosed Leopard Lizard

Blunt-nosed leopard lizards are found in upland areas with sandy soils and scattered vegetation, throughout the San Joaquin Valley and adjacent foothills. A large portion—perhaps most—blunt-nosed leopard lizard habitat has been lost or fragmented by conversion to cropland or developed land uses, and much of the remaining habitat has been degraded by human disturbance and the spread of nonnative plants. Habitat loss, fragmentation, and degradation remain the primary threats to blunt-nosed leopard lizard.

Most upland vegetation in and near the Restoration Area has been converted to cropland or developed land uses. Remaining natural upland vegetation is fragmented, and to some extent degraded from past and ongoing human activities.

However, in uplands that remain in natural vegetation, some potential and/or occupied habitat may exist, including along the Eastside Bypass. Blunt-nosed leopard lizards would be most likely to use areas adjacent to alkali scrub habitat with sandy soils, rodent burrows, and sparse vegetation.

As for upland habitats in general, cumulative effects on remaining habitat for blunt-nosed leopard lizards would result in additional habitat loss, fragmentation, and degradation.

The WY 2010 Interim Flows would not add to these cumulative effects. At present, all reaches that would receive WY 2010 Interim Flows are seasonally inundated, with the exception of Reaches 2A and 2B and portions of the Eastside Bypass, which are periodically inundated by flood flows periodically. The portions of Reaches 2A and 2B that could be inundated by WY 2010 Interim Flows are characterized by sandy riverwash and gravelly substrate. Habitat conditions in these areas are not highly suitable, and the presence of blunt-nosed leopard lizard is unlikely. Furthermore, the WY 2010 Interim Flows includes a measure to avoid affecting habitat occupied by blunt-nosed leopard lizard.

Giant Garter Snake

Giant garter snake is an aquatic snake found in aquatic and emergent wetland habitats (e.g., along ditches and canals, in rice fields) and adjacent uplands. In the San Joaquin Valley, the distribution and abundance of this species has been substantially reduced. In and near the Restoration Area, giant garter snake occurs in suitable habitat in the San Luis NWR Complex, in the Mendota Wildlife Area, and at the Mendota Pool, and is expected to occur in suitable habitat elsewhere in the Restoration Area. The species is threatened by habitat loss and fragmentation from expansion of urban areas, and habitat degradation from incompatible agricultural practices (e.g., intensive vegetation control along canals and ditches).

Effects of present and future non-Federal actions on giant garter snakes and their aquatic and wetland habitats are similar to the effects described previously for riparian habitats (see “Valley Elderberry Longhorn Beetle” above): some loss or disturbance of habitat from localized changes in land use or agricultural practices, and spread of invasive plants converting herbaceous-dominated riparian scrub and wetland vegetation to vegetation dominated by nonnative shrubs. However, the extent of these cumulative effects on giant garter snakes and their habitat would be less than described for riparian vegetation because a greater portion of giant garter snake habitat is on Federal and State land managed to sustain biodiversity.

The cumulative effect of non-Federal actions would likely be some reduction in the extent and quality of giant garter snake habitat, and this could reduce the snake population with the Restoration Area. The Proposed Action would not increase these cumulative effects. WY 2010 Interim Flows would be unlikely to substantially alter the extent or quality of existing habitat, although the increase in flow may enhance some giant garter snake habitat. Also, invasive plant management included in the WY 2010 Interim Flows would limit the spread of these species for several years, and thus reduce their degradation of giant garter snake habitat.

Western Yellow-Billed Cuckoo

Western yellow-billed cuckoos typically breed in broad, well-developed, and relatively closed-canopied, riparian forest composed of mature willows and cottonwoods. The development of water storage and flood control systems and the associated expansion of agricultural and developed land uses during the 20th century eliminated the vast majority of the Central Valley’s nesting habitat for yellow-billed cuckoo. Habitat loss remains the primary threat for this species.

As described previously (see “Valley Elderberry Longhorn Beetle” above), a substantial reduction in riparian habitat has occurred, particularly as a result of the construction of Friant Dam and the existing flood control system, and associated conversion of historical floodplain to cropland. The remaining riparian vegetation is primarily in narrow corridors, which are primarily shrub-dominated scrubs, but also includes narrow bands and some wider patches of riparian forest along all reaches of the San Joaquin River. Although yellow-billed cuckoo has not been documented as nesting in the Restoration Area during recent decades, it could potentially nest in these forests.

Most potential nesting habitat for yellow-billed cuckoo in the Restoration Area is of marginal quality and located along the San Joaquin River. As described previously (see “Valley Elderberry Longhorn Beetle” above), the extent of riparian vegetation and the quality of riparian habitats are expected to be reduced by the cumulative effect of non-Federal actions. In particular, invasive plants are likely to continue to spread through riparian areas along the San Joaquin River, and would likely reduce the extent of riparian forest providing suitable nesting habitat for yellow-billed cuckoo. The WY 2010 Interim Flows would reduce this cumulative effect because it includes a measure that would limit the expansion of invasive plant populations for several years.

Least Bell’s Vireo

The primary threats to least Bell’s vireo are habitat loss and nest parasitism by brown-headed cowbird. Threats also include trampling of vegetation and nests by livestock and humans, and habitat degradation resulting from the spread of invasive plants, particularly giant reed.

Least Bell’s vireo historically nested in riparian vegetation throughout the Restoration Area, but was extirpated from the Central Valley by 1980. The species is now expanding its range, and in 2005 and 2006, least Bell’s vireos successfully nested at the San Joaquin River NWR.

As described previously (see “Valley Elderberry Longhorn Beetle” above), the extent and habitat quality of riparian vegetation are expected to be reduced by the cumulative effect of non-Federal actions. In particular, invasive plants are likely to continue to spread through riparian areas along the San Joaquin River, and would likely reduce the extent of suitable nesting habitat for least Bell’s vireo. Also, potential nesting habitat could experience greater disturbance from human activities along Reach 1A of the San Joaquin River. The Proposed Action would not add to these cumulative effects. Least Bell’s vireos would migrate into the Restoration Area sometime in April and would naturally construct their nests above the level of Interim Flows. Furthermore, the number of nests established below the levels of Interim Flows during the breeding season is expected to be low, given the rarity of nesting lest Bell’s vireos in the Restoration Area and the prevalence of surrounding habitats suitable for nesting.

Riparian Brush Rabbit

Riparian brush rabbit inhabits riparian vegetation, but has been extirpated from the Delta and most of the lower San Joaquin River and its tributaries. Currently, this species has a very limited distribution along the lower portions of the San Joaquin and Stanislaus rivers, and is not expected to occur upstream from the confluence with the Merced River.

Riparian habitats along the San Joaquin River from the Merced River to the Delta and along the lower Stanislaus River would experience cumulative effects comparable to those in the Restoration Area (see “Valley Elderberry Longhorn Beetle” above). These cumulative effects on riparian areas would likely adversely affect riparian brush rabbit. The WY 2010 Interim Flows would not add to these cumulative effects. WY 2010 Interim Flows would have only a minimal effect on riparian habitats downstream from the Merced River; thus no impact on riparian brush rabbit would occur.

Fresno Kangaroo Rat

Fresno kangaroo rats live in alkali scrub habitat, but may be extirpated from the Restoration Area. The primary threats to Fresno kangaroo rat are habitat loss from expansion of cropland and developed land uses, and incompatible grazing practices.

As described previously (see “Palmate-Bracted Bird’s-Beak” above), alkali scrub habitats in the Restoration Area have been substantially reduced, fragmented, and degraded by conversion of natural vegetation to agricultural and developed land uses, and by the activities associated with those land uses that affect remaining natural vegetation (e.g., use of off-road vehicles and alterations to hydrology). The primary future actions affecting alkali scrub are related to agricultural activities, including changes in grazing practices, use of off-road vehicles, and conversion of natural vegetation to row or field crops. Because most—and possibly all—potential habitat in these portions of the Restoration Area is not managed to sustain biodiversity, and various agricultural activities could eliminate or degrade habitat, some additional loss or degradation of Fresno kangaroo rat habitat is likely.

Occupied or potentially suitable habitat for Fresno kangaroo rat has not been documented along the San Joaquin River or bypasses in areas seasonally inundated by river flows, and inundation of potentially suitable habitat would be avoided during implementation of WY 2010 Interim Flows. Therefore, the WY 2010 Interim Flows would not contribute to cumulative effects. WY 2010 Interim Flows also would not alter agricultural practices potentially affecting Fresno kangaroo rat in the Restoration Area.

San Joaquin (Riparian) Woodrat

The San Joaquin Valley woodrat lives in riparian areas, primarily riparian forest with a dense shrub understory. Historically, this species likely occurred throughout the northern San Joaquin Valley, but it currently has a very limited distribution at the confluence of the San Joaquin and Stanislaus rivers. It is not expected to occur upstream from the Merced River. The primary threats to San Joaquin Valley woodrat are habitat loss by conversion to cropland or clearing of vegetation, and habitat disturbance.

Riparian habitats along the lower San Joaquin River and the Stanislaus River would experience cumulative effects comparable to those in the Restoration Area (see “Valley Elderberry Longhorn Beetle” above), and these cumulative effects are likely to adversely affect San Joaquin Valley woodrat. The Proposed Action would not add to these cumulative effects. Because Interim Flows would have only a minimal effect on riparian habitats downstream from the Merced River, no impact on San Joaquin Valley woodrat would occur.

San Joaquin Kit Fox

San Joaquin kit fox is a wide-ranging carnivore that uses primarily grassland, seasonal wetland, and open scrubs and woodlands. The distribution and abundance of this species have been substantially reduced by the loss and fragmentation of habitat by conversion of natural vegetation to cropland and developed land uses, human disturbance, rodenticide use, and competitive displacement and predation by the domestic dog, red fox, and coyote.

Most natural upland vegetation in and near the Restoration Area has been converted to cropland or developed land uses. The remaining natural upland vegetation is fragmented and degraded to some extent by disturbances originating from adjacent agricultural and developed land uses. Developed and agricultural land uses have also increased the density of domestic dogs and coyotes that displace San Joaquin kit fox. However, this species still occupies some of the remaining grassland and scrub habitats in the Restoration Area.

Present and future non-Federal actions could result in additional degradation and loss of upland habitats. Also, an increased human population within the region would likely increase the abundance of coyotes and dogs that could displace San Joaquin kit fox. Potential effects of climate change and further spread of invasive species on San Joaquin kit fox are not known.

The Proposed Action would not add measurably to these cumulative effects. WY 2010 Interim Flows would not inundate occupied dens, nor would they interfere with foraging or dispersal through the river corridor or the Eastside Bypass.

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7.0 Conclusions

7.1 Aquatic Species

The Proposed Action is not likely to adversely affect delta smelt, Central Valley steelhead DPS, Sacramento River winter-run or Central Valley spring-run Chinook salmon ESUs, or green sturgeon (Table 7-1).

Table 7-1.
Federally Listed Aquatic Species That May be Affected by the WY 2010 Interim Flows

Species	Federal Status	Critical Habitat	Conclusion
Central Valley steelhead *Oncorhynchus mykiss*	T	Designated critical habitat in action area (70 *Federal Register* 52488, September 2, 2005).	Not likely to adversely affect species or adversely modify critical habitat.
Sacramento River winter-run Chinook salmon *Oncorhynchus tshawytscha*	E	Designated critical habitat not in action area (58 *Federal Register* 33212, June 16, 1993).	Not likely to adversely affect species or adversely modify critical habitat.
Central Valley spring-run Chinook salmon *Oncorhynchus tshawytscha*	T	Designated critical habitat not in action area (70 *Federal Register* 52488, September 2, 2005).	Not likely to adversely affect species or adversely modify critical habitat.
Delta smelt *Hypomesus transpacificus*	T	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Southern DPS of the North American Green Sturgeon *Acipenser medirostris*	T	No designated critical habitat.	Not likely to adversely affect species.

Note:
Federal Listing Categories:
E = Federally listed as endangered.
T = Federally listed as threatened.

7.2 Terrestrial Species

The Proposed Action is not likely to adversely affect any federally listed plant or animal species or designated critical habitat (Table 7-2). Because WY 2010 Interim Flows would be confined within the existing channel, would not increase flood flow levels, would last for only a single year, and would fall within the range of and be timed to be similar to historical flows, implementation of Interim Flows in WY 2010 would not result in adverse changes in conditions affecting listed species or their habitats along the San Joaquin River or Eastside or Mariposa bypasses during their release or later in time. In addition, the WY 2010 Interim Flows would not have adverse direct or indirect effects on listed species in the Merced, Stanislaus, or Tuolumne rivers, or the Delta because the flows would also be within the normal range and be timed to be similar to historic flows and would be confined to the existing channel.

Table 7-2.
Federally Terrestrial Species That May be Affected by the SJRRP WY 2010 Flows

Species	Federal Status	Critical Habitat	Conclusion
Succulent owl's-clover *Castilleja campestris* ssp. *succulenta*	T	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Hoover's spurge *Chamaesyce hooveri*	T	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Palmate-bracted bird's-beak *Cordylanthus palmatus*	E	None designated.	Not likely to adversely affect species.
Colusa grass *Neostapfia colusana*	T	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	T	Designated critical habitat adjacent to action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Hairy Orcutt grass *Orcuttia pilosa*	E	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Greene's tuctoria *Tuctoria greenei*	E	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Conservancy fairy shrimp *Branchinecta conservatio*	E	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Longhorn fairy shrimp *Branchinecta longiantenna*	E	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Vernal pool fairy shrimp *Branchinecta lynchi*	T	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.
Vernal pool tadpole shrimp *Lepidurus packardi*	E	Designated critical habitat in action area (70 *Federal Register* 46924–46999).	Not likely to adversely affect species or adversely modify critical habitat.

Table 7-2.
Federally Terrestrial Species That May be Affected by the SJRRP WY 2010 Flows (contd.)

Species	Federal Status	Critical Habitat	Conclusion
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	No designated critical habitat in action area (45 *Federal Register* 52803–52807).	Not likely to adversely affect species or adversely modify critical habitat.
California tiger salamander *Ambystoma californiense*	T	Designated critical habitat in action area (70 *Federal Register* 49379-49458).	Not likely to adversely affect species or adversely modify critical habitat.
Blunt-nosed leopard lizard *Gambelia sila*	E	None designated.	Not likely to adversely affect species.
Giant garter snake *Thamnophis gigas*	T	None designated.	Not likely to adversely affect species.
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	C	None designated.	Not likely to adversely affect species.
Least Bell's vireo *Vireo bellii pusillus*	E	No designated critical habitat in action area (59 *Federal Register* 4845- 4867).	Not likely to adversely affect species or adversely modify critical habitat.
Riparian brush rabbit *Sylvilagus bachmani riparius*	E	None designated.	Not likely to adversely affect species.
Fresno kangaroo rat *Dipodomys nitratoides exilis*	E	No designated critical habitat in action area (50 *Federal Register* 4222–4226).	Not likely to adversely affect species or adversely modify critical habitat.
San Joaquin (riparian) woodrat *Neotoma fuscipes riparia*	E	None designated.	Not likely to adversely affect species.
San Joaquin kit fox *Vulpes macrotis mutica*	E	None designated.	Not likely to adversely affect species.

Source: USFWS 2009

Notes:
U.S. Fish and Wildlife Service (USFWS) Federal Listing Categories:
C = Candidate for listing
E = Federally listed as endangered
T = Federally listed as threatened

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