Chapter 6
Biological Environment

This chapter provides environmental analyses relative to biological parameters of the project area. Components of this study include a setting discussion, impact analysis criteria, project effects and significance, and applicable mitigation measures. This chapter is organized as follows:

- Section 6.1, “Fish”;
- Section 6.2, “Vegetation and Wetlands”; and
- Section 6.3, “Wildlife.”

Section 6.1
Fish

Introduction

This section describes the existing environmental conditions and the consequences of implementing tidal wetland restoration and managed wetland activities on fisheries resources.

The Affected Environment discussion below describes the current setting of the plan area. The purpose of this information is to establish the existing environmental context against which the reader can understand the environmental changes caused by the action. This information is intended to be directly or indirectly relevant to the subsequent discussion of impacts.

The environmental changes associated with the alternatives are discussed under Impact Analysis. This section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary.

Summary of Impacts

Implementation of the SMP would include breaching levees to restore tidal wetlands, and increased frequency of implementation of some managed wetland activities such as repairing and upgrading existing levees, replacing infrastructure, installing fish screens, and new activities such as dredging. These actions could affect fish and fish habitat in Suisun Marsh. Repair and breaching of levees would result in less than significant impacts because environmental commitments (Chapter 2, “Environmental Commitments”) including avoidance and minimization measures, such as construction work windows, will be implemented to reduce impacts on water quality and fish in the immediate construction area. Dredging would affect fish habitat by increasing channel depth and temporarily removing benthic organisms. Additional risks to fish from dredging include injury or mortality by the dredger or benthic disturbance (especially through mobilization of fine sediments) during the dredging process itself. Creation of subtidal and low intertidal wetland habitat, through tidal restoration, will provide resting and foraging habitat for special-status fish species and possibly spawning habitat for delta smelt and Sacramento splittail. Special-status fish species will derive indirect benefits from exported primary and secondary pelagic production in low, mid and high marsh areas.

Table 6.1-1 presents a summary of the impacts on fish and any associated mitigation measures for each plan alternative. In most instances, environmental commitments will be implemented to reduce the aggregate impacts to less-than-significant levels.

Table 6.1-1. Summary of Fish Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
FISH-1: Construction-Related Temporary Impairment of Fish Survival, Growth, and Reproduction by Accidental Spills or Runoff of Contaminants (Heavy Metals)	A, B, C	Less than significant	None required	–
FISH-2: Construction-Related Temporary Reduction of Special-Status Fish Rearing Habitat Quality or Quantity through Increased Input and Mobilization of Sediment	A, B, C	Less than significant	None required	–
FISH-3: Short-Term Impairment of Delta Smelt Passage and Reduced Availability of Spawning and Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
FISH-4: Short-Term Impairment of Chinook Salmon Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
FISH-5: Short-Term Impairment of Steelhead Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
FISH-6: Short-Term Impairment of Green Sturgeon Passage and Reduced Availability of Holding and Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
FISH-7: Short-Term Impairment of Sacramento Splittail Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Velocity Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
FISH-8: Short-Term Impairment of Longfin Smelt Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Velocity Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
FISH-9: Temporary Reduction of Delta Smelt Habitat Quantity or Quality through Removal and Destruction of Cover Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
FISH-10: Temporary Reduction of Chinook Salmon Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
FISH-11: Temporary Reduction of Steelhead Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-12: Temporary Reduction of Green Sturgeon Habitat Quantity or Quality as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-13: Temporary Reduction of Sacramento Splittail Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-14: Temporary Reduction of Longfin Smelt Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-15: Improved Fish Habitat Due to Increased Dissolved Oxygen Concentrations in Tidal Channels Attributable to Restoration Activities	A, B, C	Beneficial	None required	–
FISH-16: Salinity–Related Reduction of Delta Smelt Survival, Growth, Movement, or Reproduction Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
FISH-17: Salinity–Related Reduction of Chinook Salmon Survival, Growth, or Movement as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-18: Salinity–Related Reduction of Steelhead Survival, Growth, or Movement as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-19: Salinity–Related Reduction of Green Sturgeon Survival, Growth, or Movement as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-20: Salinity–Related Reduction of Sacramento Splittail Survival, Growth, Movement, or Reproduction as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-21: Salinity–Related Reduction of Longfin Smelt Survival, Growth, Movement, or Reproduction as a Result of Restoration Activities	A, B, C	Less than significant	None required	–
FISH-22: Disturbance, Injury, or Mortality of Individual Fish Resulting from Work Adjacent to Bodies of Water	A, B, C	Less than significant	None required	–
FISH-23: Change in Fish Species Composition Attributable to Changes in Salinity or Water Quality from Managed or Natural Wetland Modifications	A, B, C	Less than significant	None required	–
FISH-24: Change in Benthic Macroinvertebrate Composition Attributable to Changes in Channel Morphology and Hydraulics as a Result of Tidal Restoration	A, B, C	Less than significant	None required	–
FISH-25: Change in Primary Productivity as a Result of Tidal Restoration	A, B, C	Beneficial	–	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Managed Wetland Activities Impacts				
FISH-26: Construction-Related Temporary Impairment of Fish Survival, Growth, and Reproduction by Accidental Spills or Runoff of Contaminants (Heavy Metals)	A, B, C	Less than significant	None required	–
FISH-27: Construction-Related Temporary Reduction of Fish Rearing Habitat Quality or Quantity through Increased Input and Mobilization of Sediment	A, B, C	Less than significant	None required	–
FISH-28: Construction-Related Mortality of Fish from Stranding	A, B, C	Less than significant	None required	–
FISH-29: Temporary Reduction of Delta Smelt, Chinook Salmon and Steelhead Habitat Quantity or Quality Attributable to Management Activities	A, B, C	Less than significant	None required	–
FISH-30: Temporary Reduction of Green Sturgeon Habitat Quantity or Quality as a Result of Management Activities	A, B, C	Less than significant	None required	–
FISH-31: Temporary Reduction of Sacramento Splittail Habitat Quantity or Quality as a Result of Management Activities	A, B, C	Less than significant	None required	–
FISH-32: Temporary Reduction of Longfin Smelt Habitat Quantity or Quality as a Result of Management Activities	A, B, C	Less than significant	None required	–
FISH-33: Reduction in Benthic Macroinvertebrate Abundance as a Result of Dredging	A, B, C	Less than significant	None required	–
FISH-34: Disturbance, Injury, or Mortality of Delta Smelt Resulting from Dredging	A, B, C	Less than significant	None required	–
FISH-35: Disturbance, Injury, or Mortality of Chinook Salmon Resulting from Dredging	A, B, C	Less than significant	None required	–
FISH-36: Disturbance, Injury, or Mortality of Steelhead Resulting from Dredging	A, B, C	Less than significant	None required	–
FISH-37: Disturbance, Injury, or Mortality of Green Sturgeon Resulting from Dredging	A, B, C	Less than significant	None required	–
FISH-38: Disturbance, Injury, or Mortality of Sacramento Splittail Resulting from Dredging	A, B, C	Less than significant	None required	–
FISH-39: Disturbance, Injury, or Mortality of Longfin Smelt Resulting from Dredging	A, B, C	Less than significant	None required	–
FISH-40: Reduction of Fish Habitat Quantity or Quality Resulting from Installation of New Riprap on Levees	A, B, C	Less than significant	None required	–

Affected Environment

Sources of Information

The following key sources of information were used in the preparation of this section:

- Schroeter, R., A. Stover, and P. B. Moyle. 2006. *Trends in Fish Populations of Suisun Marsh. January 2005–December 2005*. Annual report for Contract SAP 460001965. California Department of Water Resources. March 21, 2006.
- Suisun Ecological Workgroup. 2001. Final report to the State Water Resources Control Board. August.
- Seigel, Stuart. 2008. *Draft report of Suisun Marsh Tidal Marsh and Aquatic Habitats Conceptual Model*.
- U.S. Fish and Wildlife Service. 1996. Recovery plan for Sacramento/San Joaquin Delta native fishes.
- U.S. Fish and Wildlife Service. 2008. Biological opinion on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP).
- California Department of Fish and Game. 2009a. Fall midwater trawl survey.
- California Department of Fish and Game. 2010a. San Francisco Bay study.
- California Department of Fish and Game. 2010b. Smelt larvae survey.
- California Department of Fish and Game. 2008. Spring Kodiak survey.
- California Department of Fish and Game. 2009b. Summer townet survey.

Monitoring Surveys

Numerous programs to monitor the occurrence and relative abundance of fish species in the Delta and San Francisco Bay have, or continue to be, implemented by several resource agencies. These programs are summarized below and include mid-water trawl surveys, beach seine surveys, and townet surveys. Although some of the monitoring programs discussed below are intended to monitor a single species (e.g., the summer townet survey provides an index of striped bass abundance), their capture data, when viewed in aggregate, provide meaningful information relevant to the species' timing of occurrence and abundance relative to other species (especially nonnative species). Fish occurrence information for the plan area was gathered from, but not limited to, the following monitoring programs or surveys:

- DFG's San Francisco Bay Survey,

- DFG's Summer Townet Survey,
- DFG's Fall Midwater Trawl Survey (MWT),
- DFG's Smelt Larvae Survey,
- DFG's Spring Kodiak Survey, and
- UC Davis Suisun Marsh FishSurvey.

The San Francisco Bay Study (Bay Study) was established in 1980 to determine the effects of freshwater outflow on the abundance and distribution of all fish species and mobile crustaceans in the San Francisco Bay estuary, primarily downstream of the Delta. Abundance indices are routinely calculated for more than 35 fishes and several species of crabs and caridean shrimp (Fish et al. 2009). Delta smelt, longfin smelt, and Sacramento splittail population indices are all reported with this program. Sampling ranges from south of the Dumbarton Bridge in South San Francisco Bay, to just west of Alcatraz Island in Central San Francisco Bay, throughout San Pablo and Suisun Bays, north to the confluence of Steamboat and Cache Sloughs on the Sacramento River, and east to Old River Flats on the San Joaquin River (California Department of Fish and Game no date). In Suisun Marsh, a total of eight stations are located in Suisun Bay, Grizzly Bay and Honker Bay.

The Summer Townet Survey was initiated by DFG in 1959 to provide an index of striped bass abundance. This survey uses oblique tows in mid-channel sites located throughout the Delta, Suisun Bay, and San Pablo Bay to sample young-of-year fish. The original purpose was to predict recruitment to the adult stock but the index has proven valuable in gauging the environmental health of the estuary. Young striped bass abundance is primarily a function of Delta outflow, Delta water exports and egg production. Abundance indices for other species have also revealed important trends. For example, the index for delta smelt was useful in determining its status as a threatened species. This survey was mandated by the 1995 USFWS Biological Opinion (BO) for delta smelt on the operation of the SWP and CVP (California Department of Fish and Game no date) and continues to be used to determine delta smelt abundance. Ten sites in Suisun Marsh are surveyed; five in Suisun Bay, one in Honker Bay, one in Grizzly Bay, and three in Montezuma Slough.

The Fall MWT was initiated by DFG in 1967 and was originally designed to determine the relative abundance and distribution of age-0 striped bass in the estuary, but its data is also used for other upper estuary pelagic species, including American shad, threadfin shad, delta smelt, and longfin smelt. DFG records the occurrence of other fish species in most years. This monitoring program currently samples 100 sites extending from San Pablo Bay to Rio Vista on the lower Sacramento River, and to Stockton on the San Joaquin River (California Department of Fish and Game no date). Thirty-five sampling sites are located in Suisun Bay, Honker Bay, Grizzly Bay and Montezuma Slough.

The Smelt Larvae Study was initiated by DFG in January 2009 and provides near real-time distribution data for longfin smelt larvae in the Delta, Suisun Bay and

Suisun Marsh. These data are used by agency managers to assess vulnerability of longfin smelt larvae to entrainment in south Delta export pumps. Sampling takes place within the first two weeks in January and repeats every other week through the second week in March. A total of seven sampling sites are in Suisun Marsh: three in Montezuma Slough and four in Suisun Bay (California Department of Fish and Game no date).

The Spring Kodiak Trawl Survey runs every other week beginning January or February. Each ‘Delta-wide’ survey takes 4–5 days and samples 39 stations from the Napa River to Stockton on the San Joaquin River, and up to Walnut Grove on the Sacramento River. The ‘Delta-wide’ survey locates the areas of highest adult delta smelt concentration, and is followed by a ‘Supplemental Survey’ 2 weeks later. The ‘Supplemental Survey’ is designed to sample these areas of high concentration intensively, to estimate the proportion of ripe, unripe, and spent delta smelt (California Department of Fish and Game no date).

The UC Davis Suisun Marsh fish study was initiated in 1979 as a way to monitor fish populations in response to modifications being made affecting the way water moves through the Marsh. The California Department of Water Resources funds this study. The study focuses on the entire assemblage of fishes in the Marsh examining such factors as changes in species abundance and composition through time, use of the various habitats within the Marsh, and association of changes in the fish assemblages with natural and anthropogenic changes. There have been two major components to the Suisun Marsh fish study: juvenile and adult sampling and larval fish sampling. The larval fish sampling component was initiated in 1994 and discontinued after 2002. The larval fish sampling was conducted to gain a better understanding of larval fish use of Suisun Marsh. At present only juvenile and adult fishes are sampled (Schroeter et al. 2006). All fish species are discussed and reported annually.

Environmental Conditions

This section describes the life history, habitat requirements, and factors that affect the abundance of special-status fish species for the assessment of impacts of implementing the SMP. The response of special-status fish species to project actions provides an indicator of the potential response of other species. The full range of environmental conditions and fish habitat elements potentially affected is encompassed by the assessment for the species specifically discussed.

Table 6.1-2 lists native and nonnative fishes captured in Suisun Marsh from the UC Davis Study conducted from 1979 to 2006 (Schroeter et al. 2006).

Table 6.1-2. Suisun Marsh Fish Species Potentially Affected by the Proposed Alternatives

Common Name	Scientific Name	Distribution
Native Species		
Bay pipefish	*Syngnathus leptorhynchus*	San Francisco Bay estuary
California halibut	*Paralichthys californicus*	San Francisco Bay estuary
Chinook salmon (winter-, spring-, fall-, and late fall–runs)	*Oncorhynchus tshawytscha*	Central Valley rivers; Delta; San Francisco Bay estuary
Delta smelt	*Hypomesus transpacificus*	Delta and San Francisco Bay estuary
Green sturgeon	*Acipenser medirostris*	Central Valley rivers; Delta; San Francisco Bay estuary
Hardhead	*Mylopharodon conocephalus*	Central Valley rivers; Delta
Hitch	*Lavina exilicauda*	Central Valley rivers; Delta
Longfin smelt	*Spirinchus thaleichthys*	Delta and San Francisco Bay estuary
Longjaw mudsucker	*Gillichthys mirabilis*	San Francisco Bay estuary
Northern anchovy	*Engraulis mordax*	San Francisco Bay estuary
Pacific herring	*Clupea harengeus*	San Francisco Bay estuary
Pacific sanddab	*Citharichthys sordidus*	San Francisco Bay estuary
Pacific staghorn sculpin	*Leptocottus armatus*	San Francisco Bay estuary
Plain midshipman	*Porichthys notatus*	San Francisco Bay
Sacramento blackfish	*Orthodon microlepidotus*	Central Valley rivers; Delta
Sacramento pikeminnow	*Ptychocheilus grandis*	Central Valley rivers; Delta
Sacramento sucker	*Catostomus occidentalis*	Central Valley rivers; Delta
Shiner perch	*Cymatogaster aggregata*	San Francisco Bay estuary
Speckled sanddab	*Citharichthys stigmaeus*	San Francisco Bay estuary
Sacramento splittail	*Pogonichthys macrolepidotus*	Central Valley rivers; Delta; San Francisco Bay estuary
Starry flounder	*Platichthys stellatus*	San Francisco Bay estuary
Steelhead/rainbow trout	*Oncorhynchus mykiss*	Central Valley rivers; Delta; San Francisco Bay estuary
Surf smelt	*Hypomesus pretiosus*	San Francisco Bay estuary
Threespine stickleback	*Gasterosteus aculaetus*	Central Valley rivers; Delta; San Francisco Bay estuary
Tule perch	*Hysterocarpus traskii*	Central Valley rivers; Delta
White croaker	*Genyonemus lineatus*	San Francisco Bay
White sturgeon	*Acipenser transmontanus*	Central Valley rivers; Delta; San Francisco Bay estuary
Nonnative Species		
American shad	*Alosa sapidissima*	Central Valley rivers; Delta; San Francisco Bay estuary
Bigscale logperch	*Percina macrolepida*	Central Valley rivers; Delta
Black bullhead	*Ameiurus melas*	Central Valley rivers and reservoirs; Delta
Black crappie	*Pomoxis nigromaculatus*	Central Valley rivers and reservoirs; Delta
Bluegill	*Lepomis macrochirus*	Central Valley rivers and reservoirs; Delta
Brown bullhead	*Ameiurus nebulosus*	Central Valley rivers and reservoirs; Delta

Common Name	Scientific Name	Distribution
Common carp	*Cyprinus carpio*	Central Valley rivers and reservoirs; Delta
Channel catfish	*Ictalurus punctatus*	Central Valley rivers and reservoirs; Delta
Fathead minnow	*Pimephales promelas*	Central Valley rivers and reservoirs; Delta
Goldfish	*Carassius auratus*	Central Valley rivers and reservoirs; Delta
Green sunfish	*Lepomis cyanellus*	Central Valley rivers and reservoirs; Delta
Inland silverside	*Menidia audena*	Central Valley rivers; Delta
Largemouth bass	*Micropterus salmoides*	Central Valley rivers and reservoirs; Delta
Mosquito fish	*Gambusia affinis*	Central Valley rivers and reservoirs; Delta
Rainwater killifish	*Lucania parva*	Delta and San Francisco Bay estuary
Redear sunfish	*Lepomis microlophus*	Central Valley rivers and reservoirs; Delta
Shimofuri goby	*Tridentiger bifasciatus*	San Francisco Bay
Shokihaze goby	*Tridentiger barbatus*	San Francisco Bay
Striped bass	*Morone saxatilis*	Central Valley rivers and reservoirs; Delta; San Francisco Bay estuary
Threadfin shad	*Dorosoma petenense*	Central Valley rivers and reservoirs; Delta
Wakasagi	*Hypomesus nipponensis*	Central Valley rivers and reservoirs; Delta
Warmouth	*Lepomis gulosus*	Central Valley rivers and reservoirs; Delta
White catfish	*Ameiurus catus*	Central Valley rivers; Delta
White crappie	*Pomoxis annularis*	Central Valley rivers and reservoirs; Delta
Yellowfin goby	*Acanthogobius flavimanus*	Delta; San Francisco Bay estuary

Central Valley steelhead, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley fall-/late fall–run Chinook salmon, delta smelt, longfin smelt, Sacramento splittail, and green sturgeon are listed and special-status native species that occur in Suisun Marsh. Table 6.1-3 shows the status, distribution of these species in the project area, and likelihood of occurrence, and describes any designated critical habitat.

This section describes the key environmental requirements for each life stage of the selected species. Table 6.1-4 shows the assumed months of presence for special-status fish species, for each life stage that occurs in Suisun Marsh. The dark areas indicate the periods of assumed presence. Actual occurrence and relative abundance may vary between months and from year to year.

Table 6.1-3. Special-Status Fish Species with the Potential to Occur in the Study Area

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Critical habitat designated
Central Valley spring-run Chinook salmon *Oncorhynchus tshawytscha*	T/CT	Upper Sacramento River and Feather River	Occurs in well-oxygenated, cool, riverine habitat with water temperatures from 8.0 to 12.5°C. Coldwater pools are needed for holding adults (Moyle 2002).	Migration through Suisun Bay.	Yes, but not in project area.
Sacramento River winter-run Chinook salmon *Oncorhynchus tshawytscha*	E/CE	Mainstem Sacramento River below Keswick Dam (Moyle 2002)	Occurs in well-oxygenated, cool, riverine habitat with water temperatures from 8.0 to 12.5°C. Habitat types are riffles, runs, and pools (Moyle 2002).	Migration through Suisun Bay.	Yes, but not in project area.
Central Valley fall-/late fall–run Chinook salmon *Oncorhynchus tshawytscha*	SC/CSC	Sacramento and San Joaquin rivers and tributary Central Valley rivers	Occurs in well-oxygenated, cool, riverine habitat with water temperatures from 8.0 to 12.5°C. Habitat types are riffles, runs, and pools (Moyle 2002).	Species observed in the study area. Suitable habitat in the study area.	No
Central California coast steelhead *Oncorhynchus mykiss*	T/–	Russian River to Soquel Creek, Santa Cruz Co.	Cold, clear water with clean gravel of appropriate size for spawning. Most spawning occurs in headwater streams. Steelhead migrate to the ocean to feed and grow until sexually mature.	Species observed in fresh water creeks above the study area.	Yes, but not in project area.
Central Valley steelhead *Oncorhynchus mykiss*	T/–	Sacramento River and tributary Central Valley rivers	Occurs in well-oxygenated, cool, riverine habitat with water temperatures from 7.8 to 18°C (Moyle 2002). Habitat types are riffles, runs, and pools.	Migration through Suisun Bay. Species observed in fresh water creeks above the study area.	Yes, but not in project area.
Green sturgeon (southern DPS) *Acipenser medirostris*	T/CSC	Sacramento, Klamath and Trinity rivers (Moyle 2002)	Spawn in large river systems with well-oxygenated water, with temperatures from 8.0 to 14°C	The study area may provide rearing habitat for juveniles and some adults.	Yes; all tidally influenced areas of Suisun Bay and Grizzly Bay up to the elevation of mean higher high water

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Critical habitat designated
Delta smelt *Hypomesus transpacificus*	T/CE	Primarily in the Sacramento–San Joaquin estuary, but has been found as far upstream as the mouth of the American River on the Sacramento River and Mossdale on the San Joaquin River; range extends downstream to San Pablo Bay	Occurs in estuary habitat in the Delta where fresh and brackish water mix in the salinity range of 2–7 parts per thousand (Moyle 2002).	Found throughout the study area.	Yes; the entire Marsh area and bays are designated as critical habitat.
Longfin smelt *Spirinchus thaleichthys*	–/CT	Within California, mostly in the Sacramento River–San Joaquin River Delta, but also in Humboldt Bay, Eel River estuary, and Klamath River estuary.	Salt or brackish estuary waters with freshwater inputs for spawning.	Found throughout the study area.	No
Sacramento splittail *Pogonichthys macrolepidotus*	–/CSC	Occurs throughout the year in low-salinity waters and freshwater areas of the Sacramento–San Joaquin Delta, Yolo Bypass, Suisun Marsh, Napa River, and Petaluma River (Moyle 2002).	Spawning takes place among submerged and flooded vegetation in sloughs and the lower reaches of rivers.	Found throughout the study area.	No

[1] Status:

Federal

E = Listed as endangered under the federal Endangered Species Act (ESA).

T = Listed as threatened under ESA.

SC = Listed as a species of concern.

– = No federal status.

State

CE = Listed as endangered under the California Endangered Species Act (CESA).

CT = Listed as threatened under CESA.

CSC = California species of special concern.

– = No state status.

Table 6.1-4. Fish Life Stage Timing in Suisun Marsh

Life Stage	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Central Valley Spring-Run Chinook Salmon													
Adult migration	Upper Sacramento River and Tributaries			■	■	■	■	■	■				
Juvenile (young of year) movement and rearing	Upper Sacramento River and Tributaries		■	■	■	■	■						
Yearling movement	Upper Sacramento River and tributaries to San Francisco Bay	■	■	■							■	■	■
Central Valley Fall-Run Chinook Salmon													
Adult migration	Upper Sacramento River and Tributaries, Mokelumne River and San Joaquin River Tributaries, Suisun Marsh							■	■	■	■	■	■
Juvenile movement and rearing	Upper Sacramento River and Tributaries, Mokelumne River and San Joaquin River Tributaries, Suisun Marsh	■	■	■	■	■	■						
Central Valley Late Fall-Run Chinook Salmon													
Adult migration	Sacramento River and Tributaries	■	■	■	■						■	■	■
Juvenile movement and rearing	Upper Sacramento River and Tributaries, Mokelumne River and San Joaquin River Tributaries	■	■	■	■						■	■	■
Sacramento Winter-Run Chinook Salmon													
Adult migration	Upper Sacramento River	■	■	■	■	■	■	■					■
Juvenile movement and rearing	Lower Sacramento River and Delta	■	■	■	■								
Steelhead													
Adult migration	Suisun Marsh	■	■	■								■	■
Juvenile rearing	Suisun Marsh	■											
Juvenile movement	Upper Sacramento River and Tributaries to San Francisco Bay	■	■	■	■	■	■						■
Longfin Smelt													
Spawning		■	■	■	■	■	■					■	■

Life Stage	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult and juvenile rearing	Suisun Marsh	■	■	■	■	■				■	■	■	■
Larvae	Suisun Marsh		■	■	■	■							
Green Sturgeon													
Adult migration	Suisun Bay	■	■	■	■	■					■	■	■
Juvenile rearing*	Suisun Marsh	■	■	■	■	■	■	■	■	■	■	■	■
Juvenile migration*	Suisun Marsh, Suisun Bay	■	■	■	■	■	■	■	■	■	■	■	■
Sacramento Splittail													
Adult migration	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Sacramento River and San Joaquin River	■	■	■	■								■
Spawning	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Lower Sacramento and San Joaquin rivers	■	■	■	■	■							
Larval and early juvenile rearing and movement	Suisun Marsh, Upper Delta, Yolo Bypass, Sutter Bypass, Lower Sacramento and San Joaquin rivers			■	■	■	■						
Adult and juvenile rearing	Delta, Suisun Bay	■	■	■	■	■	■	■	■	■	■	■	■
Delta Smelt													
Adult migration	Delta	■	■	■									■
Spawning	Delta, Suisun Marsh	■	■	■	■	■							
Larval and early juvenile rearing	Suisun Marsh			■	■	■	■						
Estuarine rearing: juveniles and adults	Suisun Marsh	■	■	■	■	■				■	■	■	■

■ Primary occurrence included in the assessment of plan impacts.

* Juvenile life history in unknown. Assume in Suisun Marsh area year round.

Sources: Rosenfield and Baxter 2007; Wang and Brown 1993; U.S. Fish and Wildlife Service 1996; McEwan 2001; Moyle 2002; Hallock 1989.

Habitat quality and quantity have been identified as key factors influencing fish abundance and distribution in Suisun Marsh and San Francisco Bay estuary (Unger 1994). Habitat types important to the native fishes of Suisun Marsh include shallow bays and channels; tidal flats; and low, mid, and high tidal marshes (Goals Project 1999). Fish use of the Marsh is also reflective of water quality conditions such as salinity, water transparency/turbidity, and water temperature.

Moyle et al. (1983) identified two assemblages of fish in the Marsh—a native fish assemblage that existed in the dead-end sloughs and an assemblage of introduced and seasonal species that existed in the main channels. Native fish species found in dead-end sloughs include threespine stickleback and Sacramento splittail. Introduced species include striped bass, white catfish and common carp. Seasonal species are longfin smelt and delta smelt. Meng et al. (1994) confirmed that native species were found more often in small dead-end sloughs, and seasonal species were found in larger sloughs; introduced species were found in both habitats (Suisun Ecological Workgroup 2001). Matern et al. (1997, 1998, 2002) compared fish capture data from the UC Davis Suisun Marsh fish surveys for different years as discussed below.

Matern et al. (1997) compared slough data from 1995 to1996 and found that species diversity was highest in Spring Branch Slough and lowest in Nurse Slough. Their findings indicated species diversity was lower in all large and medium-sized sloughs than in small sloughs, except for Boynton Slough. Matern et al. (1998) conducted a similar analysis using data from 1995 through 1997, which indicated that the highest catch per trawl occurred in Spring Branch Slough, while the lowest occurred in Boynton Slough. Boynton Slough receives outflow from the Fairfield Sewage Treatment Plant, and Spring Branch is one of the few remaining areas of undiked tidal wetlands in Suisun Marsh (the Solano Farmlands and Open Space Foundation's Rush Ranch). However, Matern et al. (1998) note their results could reflect decreases in gear efficiency in the larger sloughs (Suisun Ecological Workgroup 2001). Overall they indicate species diversity and native fish abundance tend to be higher in smaller sloughs than in medium and large sloughs. As habitat complexity tends to be higher in smaller sloughs, these studies suggest habitat complexity is important to native fish abundance and distribution (Matern et al. 1997). The Suisun Ecological Workgroup (2001) suggests efforts to increase acreage and to rehabilitate edge habitat (e.g., shallow water, tidal), could lead to increases in native fish populations in the Marsh.

Matern et al. (2002) compared fish species abundance and distribution throughout Suisun Marsh with water quality parameters such as temperature, salinity, water transparency/turbidity, and freshwater inflow. Species abundance and distribution were related to four interacting factors: (1) timing and place of reproducing fish populations; (2) past reproductive success; (3) habitat differences between sloughs, and (4) physiological tolerances. Native fish species peaked in abundance during the early part of the year (January through July) while nonnative warmer water fish were most abundant mid-June to

September (page 805) indicating water temperature was a limiting factor. Native fish species abundance has declined since 1979, but has fluctuated at lower levels from 1990 to 1999 in the Marsh. Further declines in delta smelt and longfin smelt abundance from years 2000 to 2007 have been seen throughout the San Francisco estuary (Baxter et al. 2008). Nonnatives have followed the same pattern but remain more abundant than native species. Larvae of native fish appear in the winter through early spring, and nonnative larval fish appear later in the spring into the summer. The low variability of salinity and water temperature in Suisun Marsh allows fish to use the Marsh most of the year. Nonnative fish and invertebrate species will continue to be introduced into the Marsh primarily through ballast water.

Matern et al. (2002) also compared fish capture data between sloughs. The differences between slough size and chemical attributes of the sloughs determined fish composition. The largest sloughs had the least numbers of fish captured and least diversity. However, in larger sloughs there is a decrease in efficiency of sampling techniques. Boynton Slough is the exception to the rule. Although one of the smaller sloughs, it had low diversity and fish numbers. One reason may be that Boynton Slough receives sewage outflow from the Fairfield Sewage Treatment Plant. Water quality constituents may be unfavorable and limit fish species that could occur in the slough (Stover et al. 2005). Physical characteristics (substrate, position relative to other water bodies) of various sloughs also may play a part in where particular fish species are residing. High densities of threespine stickleback were captured near duck pond drains, indicating habitat preferences (Matern et al. 2002).

To summarize the three studies, the highest numbers of species are found in the smaller sloughs. Juvenile native species use the Marsh as a rearing area in the winter and spring months, while nonnative species use the Marsh in the summer and early fall months when the water is warmer. Native fish species population numbers have declined over the years.

Water quality conditions also reflect fish use in the Marsh. A literature review found most adult and juvenile fish species have a broad range of salinity tolerances, and changes in salinity throughout the year would not affect their abundance (Wang 1986). Native fish use of Suisun Marsh reflects salinity preferences—fish species that prefer higher salinity are present in the Marsh when salinities are higher and vice versa for fish species with lower tolerance. The majority of nonnative fish species prefers low salinity and inhabits the Marsh during low-salinity periods. Low-salinity periods typically are from spring to early summer when outflow is high. During the months of February through June, native fish species are spawning and rearing in the Marsh and require salinity less than 5 ppt. Many fish are larvae, juveniles, and young-of-the-year fish that were spawned upstream in freshwater areas but rear in the Marsh in the spring (Suisun Ecological Workgroup 2001). During dry and critical dry years, salinities are high and may preclude native fish from spawning. Higher salinities are seen in the summer into fall. The Suisun Ecological Workgroup (2001) has suggested keeping salinity variable from July to January to preclude nonnative fish species from establishing in the Marsh.

Table 6.1-5. Salinity and Velocity Tolerances of Special-Status Fish Species in Suisun Marsh

Species	Salinity[a]	Velocity
Longfin Smelt	Tolerance range: 0 to pure seawater Spawning: 0 to 0.5ppt Egg: 0 to 0.5 ppt Larvae: ≥0 ppt Juveniles: ≥0.5 ppt Adult: ≥0 ppt Larvae and early juveniles: 1.1 to 18.5 ppt	No information found.
Delta Smelt	Tolerance range: 0 to 18 ppt; 19 ppt lethal limit Spawning: 0 to 0.5ppt Egg: 0 to 5 ppt Larvae: 0 to 5 ppt Juveniles: 0.5 to 10 ppt Adult: 0.5 to 10 ppt Larvae and early juveniles: 0.3 to 1.8 ppt	Juveniles/adults <0.33 ft /s to 0.89 ft/s for 10 minute interval (Bennett 2003:15)
Chinook Salmon	Tolerance range: 0 to 32 ppt Spawning: 0 to 0.5 ppt Egg: 0 to 0.5 ppt Larvae: 0 to 0.5 ppt Juveniles: ≥ 0 ppt Adult: ≥ 0 ppt	Juvenile 0–1.97 ft/s preferred velocity (Raleigh 1986:11) Adult cruising speed 0–4 ft/sec (Bell 1991, 1986 cited in Frei 2006)
Steelhead	Tolerance range: 0 to 32 ppt Spawning: 0 to 0.5ppt Egg: 0 to 0.5 ppt Larvae: 0 to 0.5 ppt Juveniles: ≥ 0 ppt Adult: ≥ 0 ppt	Juvenile 0–0.98 ft/s preferred velocity (Raleigh 1984:8) Adult cruising speed 0–5 ft/sec (Bell 1991, 1986 cited in Frei 2006)
Sacramento Splittail	Tolerance range: 0 to 28 ppt; 22 to 27 ppt lethal limit (depends on size) Spawning: 0 to 5 ppt Egg: 0 to 5 ppt Larvae: 0 to 5 ppt Juveniles: 0 to 5 ppt Adult: 0 to 5 ppt Larvae and early juveniles: 0–8 ppt	Juvenile 0.66–1.31 ft/s critical swimming speed (Young and Cech 1996:671) Adult 1.31–2.07 ft/s critical swimming speed (Young and Cech 1996:671)
Green Sturgeon	Tolerance range: 0 to 32 ppt Spawning: 0 to 0.5 ppt Egg: 0 to 0.5 ppt Larvae: 0 to 0.5 ppt Juveniles: ≥0 ppt Adult: ≥0 ppt Juvenile tolerance depends on length. At 7 months, can tolerate 32 ppt (Allen et al. 2003)	Juvenile/adult 1.31–2.62 ft/s critical swimming speed (dependent on body size) (Allen et al. 2006:1365)

Species	Salinity[a]	Velocity

ft/s = feet per second.

[a] From Suisun Ecological Workgroup 2001.

[b] Allen et al. 2003.

Special-Status Fish Species Life History

Chinook Salmon

Four distinct runs of Chinook salmon occur in the Sacramento River system: winter-run, spring-run, fall-run, and late fall–run. Chinook salmon are anadromous fish, meaning that adults live in marine environments and return to their natal freshwater streams to spawn. Juveniles rear in freshwater for a period of up to 1 year until smoltification (i.e., a physiological preparation for survival in marine environs) and subsequent ocean residence.

Sacramento Winter-Run

Both ESA and CESA list winter-run Chinook salmon evolutionarily significant unit (ESU) as an endangered species. Critical habitat for winter-run Chinook salmon includes the Sacramento River from Keswick Dam (River Mile [RM] 302) to Chipps Island (RM 0) in the Delta (National Marine Fisheries Service 1997).

Adult winter-run Chinook salmon immigration (upstream migration) through the Delta and into the Sacramento River occurs from December through July, with peak immigration from January through April (Table 6.1-4). Winter-run Chinook salmon primarily spawn in the mainstem Sacramento River between Keswick Dam (RM 302) and the Red Bluff Diversion Dam (RM 242). Winter-run Chinook salmon spawn between late April and mid-August, with peak spawning generally occurring in June (Snider et al. 2000).

Juvenile emigration (downstream migration) past the Red Bluff Diversion Dam (RM 242) begins in late July, peaks during September, and may extend through mid-March (National Marine Fisheries Service 1997). The peak period of juvenile emigration through the lower Sacramento River into the Delta generally occurs between January and April (National Marine Fisheries Service 1997) (Table 6.1-4). Differences in peak emigration periods between these two locations suggest that juvenile winter-run Chinook salmon may exhibit a sustained residence in the upper or middle reaches of the Sacramento River before entering the lower Sacramento River/Delta. Although the location and extent of rearing in these lower or middle reaches is unknown, it is believed that the duration of fry presence in an area is directly related to the magnitude of river flows during the rearing period (Stevens 1989).

Central Valley Spring-Run

The Central Valley spring-run Chinook salmon ESU, which includes populations spawning in the Sacramento River and its tributaries, is listed as threatened under ESA and CESA. Spring-run Chinook salmon historically occurred from the upper tributaries of the Sacramento River to the upper tributaries of the San Joaquin River. However, they have been extirpated from the San Joaquin River system. The only streams in the Central Valley with remaining wild spring-run Chinook salmon populations are the Sacramento River and its tributaries, including the Yuba River, Mill Creek, Deer Creek, and Butte Creek. Critical habitat is designated for spring-run Chinook salmon in the Sacramento River and upper tributaries. Critical habitat does not include Suisun Marsh (70 FR 52531).

Spring-run Chinook salmon enter the Sacramento River from late March through September (Reynolds et al. 1993), but peak abundance of immigrating adults in the Delta and lower Sacramento River occurs from April through June (Table 6.1-4). Adult spring-run Chinook salmon remain in deep-water habitats downstream of spawning areas during summer until their eggs fully develop and become ready for spawning. Spring-run Chinook salmon spawn primarily upstream of the Red Bluff Diversion Dam in the mainstem Sacramento River and the aforementioned tributaries. Spawning occurs from mid-August through early October (Reynolds et al. 1993). A small portion of an annual year-class may emigrate as post-emergent fry (less than 1.8 inches long) and reside in the Delta undergoing smoltification. However, most are believed to rear in the upper river and tributaries during winter and spring, emigrating as juveniles (more than 1.8 inches long). The timing of juvenile emigration from the spawning and rearing reaches can vary depending on tributary of origin and can occur from November through June (Table 6.1-4).

Central Valley Fall-/Late Fall–Run

Central Valley fall-run and late fall–run Chinook salmon are commercially and recreationally important. These ESUs are federal species of concern. Because the fall-run Chinook salmon is currently the largest run of Chinook salmon in the Sacramento–San Joaquin River system, it continues to support commercial and recreational fisheries of significant economic importance.

In general, adult fall-run Chinook salmon migrate into the Sacramento River, San Joaquin River, and its tributaries from July through December, with immigration peaking from mid-October through November (Table 6.1-4). Fall-run Chinook salmon spawn in numerous tributaries of the Sacramento River, including the lower American River, lower Yuba River, Feather River, and tributaries of the upper Sacramento River. Most mainstem Sacramento River spawning occurs between Keswick Dam and the Red Bluff Diversion Dam. Fall-run fish also spawn in the San Joaquin River. Spawning generally occurs from October through December, with fry emergence typically beginning in late December and January. Fall-run Chinook salmon emigrate as post-emergent fry, juveniles, and smolts after rearing in their natal streams for up to 6 months. Consequently, fall-run emigrants may be present in the lower Sacramento River from January through June (Reynolds et al. 1993) (Table 6.1-4) and remain in the Delta for variable lengths of time before ocean entry.

Adult immigration of late fall–run Chinook salmon into the Sacramento River generally begins in October, peaks in December, and ends in April (Moyle et al. 1995) (Table 6.1-4). Primary spawning areas for late fall–run Chinook salmon are located in tributaries of the upper Sacramento River (e.g., Battle Creek, Cottonwood Creek, Clear Creek, Mill Creek), although late fall–run Chinook salmon are believed to return to the Feather and Yuba Rivers as well (Moyle et al. 1995). Juveniles emigrate through the lower Sacramento River primarily from October through April (Table 6.1-4).

Myrick and Cech (2001) have compiled the most comprehensive review of temperature effects on Central Valley Chinook salmon to date. These water temperatures apply to all runs of Chinook salmon. Chinook salmon eggs can survive at temperatures ranging from 35 to 62°F, but highest survival rates occur between approximately 45 and 50°F. Survival of juvenile Chinook salmon under high temperatures is a function of acclimation temperature and exposure time. In general, the maximum temperature at which eggs can survive is positively correlated with acclimation temperature. The reported chronic upper lethal limit for Central Valley Chinook salmon is approximately 77°F, although temperatures approaching 84°F may be tolerated for short periods. Growth of juvenile Chinook salmon occurs at temperatures ranging from approximately 46 to 77°F, with maximum to near-maximum growth rates reached at approximately 56 to 68°F (Myrick and Cech 2001).

Occurrence in Plan Area

Chinook salmon have been captured over the years in small numbers during the Summer Townet and the Fall Midwater Trawl surveys in Suisun, Grizzly, and Honker Bays and Montezuma Slough.

Five adult Chinook salmon and numerous juvenile salmon have been captured during the UC Davis Suisun Marsh fish surveys (1979 to 2005). Juveniles were measured and identified as fall-run Chinook salmon using the Fisher (1992) length at date criteria (Schroeter et al. 2006:10). Denverton, Suisun, Montezuma, Goodyear, Spring Branch, and Grant Sloughs were the primary areas of capture, with Denverton Slough having the most captured fish (Figure 5.6-3, “Surface Waters in and around Suisun Marsh”). Beach seining was the primary mode of capture, indicating that most were found in shallow-water habitat (Bay Delta and Tributaries no date). Juvenile Chinook salmon also are thought to rear in Suisun Marsh during some years, such as 1995 when presence and growth were seen for several months (Schroeter et al. 2006:10). Rearing juveniles move out of the Marsh once water temperatures reach above 17°C and is the determining factor on how long fish will stay in the Marsh (Schroeter et al. 2006:10).

Steelhead (Central California Coast and Central Valley)

Central California coast and Central Valley steelhead are both federally listed as threatened. Steelhead have one of the most complex life histories of any salmonid species. *O. mykiss* either can be anadromous and called *steelhead* or complete their life cycle within a given river reach. Freshwater residents typically are referred to as rainbow trout.

Historical records indicate that adult steelhead enter the mainstem Sacramento River in July, peak in abundance in September and October, and continue migrating through February or March (McEwan and Jackson 1996; Hallock 1989). Most steelhead spawn from December through April, with peak spawning occurring from January through March (Table 6.1-4). Unlike Pacific salmon, some steelhead may survive to spawn more than one time, returning to the ocean between spawning migrations.

Newly emerged steelhead fry use shallow, protected areas along streambanks and move to faster, deeper areas of the river as they grow. Most juveniles occupy riffles in their first year of life, and some of the larger steelhead live in deep fast runs or in pools. Juvenile steelhead feed on a variety of aquatic and terrestrial insects and other small invertebrates.

Juvenile steelhead migration to the ocean generally occurs from December through August (Table 6.1-4). Most Sacramento River steelhead migrate in spring and early summer (Reynolds et al. 1993). Sacramento River steelhead generally migrate as 1-year-olds (smolts) at a length of 6 to 8 inches (15.2 to 20.3 centimeters [cm]) (Barnhart 1986; Reynolds et al. 1993).

Occurrence in Plan Area

Small numbers of steelhead were captured during Fall Mid Water Trawl surveys in Suisun, Honker, Grizzly Bays and Montezuma Slough. Eleven steelhead have been captured in Suisun Marsh (1982 to 2002) during the UC Davis sampling. One juvenile, one smolt, and 9 adults ranging from 293 millimeters (mm) to 398 mm have been caught— all in November through February, with most caught in January (Bay Delta and Tributaries no date). Most fish were caught in Denverton Slough, followed by Peytonia, Spring Branch, Cutoff, and Montezuma Sloughs. Steelhead have not been caught since 2002 (Bay Delta and Tributaries no date). It is unknown how steelhead are using Suisun Marsh, but possibly they are using the Marsh as a migratory area either to freshwater streams such as Green Valley Creek and Suisun Creek to spawn (adults) or outmigration to the ocean (juveniles and smolts) (Table 6.1-4).

Longfin Smelt

Longfin smelt has been listed as a threatened species under CESA (April 9, 2010). Historically, longfin smelt populations were found in the Klamath, Eel, and San Francisco estuaries, and in Humboldt Bay. From recent sampling, populations reside at the mouth of the Klamath River and the Russian River estuary. In the Central Valley, longfin are rarely found upstream of Rio Vista or Medford Island in the Delta. Adults concentrate in Suisun, San Pablo, and North San Francisco Bays (Moyle 2002).

Longfin smelt are anadromous, euryhaline, and nektonic (free-swimming). Adults and juveniles are found in estuaries and can tolerate salinities from 0 ppt to pure seawater. The salinity tolerance of longfin smelt larvae and early juveniles ranges from 1.1 to 18.5 ppt. After the early juvenile stage, they prefer salinities in the 15–30 ppt range (Moyle 2002) (Table 6.1-5). Longfin smelt in the San Francisco estuary spawn in fresh or slightly brackish water (Moyle 2002: 236). Prior to spawning, these fish aggregate in deepwater habitats available in the northern Delta, including primarily the channel habitats of Suisun Bay and the Sacramento River (Rosenfield and Baxter 2007). Catches of gravid adults and larval longfin smelt indicate that the primary spawning locations for these fish are in or near the Suisun Bay channel, the Sacramento River channel near Rio Vista, and (at least historically) Suisun Marsh (Wang 1991; Moyle 2002; Rosenfield and Baxter 2007). Moyle (2002) indicated that longfin smelt may spawn in the San Joaquin River as far upstream as Medford Island. Two sampling programs operated by DFG during the spawning season—the Fall Mid-Water Trawl and the Bay Study—found most of the juveniles were caught in the lower Sacramento River and Suisun Bay. In the Delta, longfin smelt spend most of their life cycle in deep, cold, brackish-to-marine waters of the Delta and nearshore environments (Moyle 2002; Rosenfield and Baxter 2007). They are capable of living their entire life cycle in fresh water, as demonstrated by landlocked populations.

Prespawning adults are generally restricted to brackish (2–35 ppt) or marine habitats. In the fall and winter, yearlings move upstream into fresh water to spawn (Table 6.1-4). Spawning may occur as early as November, and larval surveys indicate it may extend into June (Moyle 2002) (Table 6.1-4). The exact nature and extent of spawning habitat are still unknown for this species (Moyle 2002), although major aggregations of gravid adults occur in the northwestern Delta and eastern Suisun Bay (Rosenfield and Baxter 2007).

Embryos hatch in 40 days at 7°C and are buoyant. They move into the upper part of the water column and are carried into the estuary. High outflows transport the larvae into Suisun and San Pablo Bays. In low outflow years, larvae move into the western Delta and Suisun Bay. Higher outflows are reflected positively in juvenile survival and adult abundance. Rearing habitat is highly suitable in Suisun and San Pablo Bays in part because juveniles require brackish water in the 2–18 ppt range (Table 6.1-5). Longfin smelt are pelagic foragers that feed extensively on copepods, amphipods, and shrimp (U.S. Fish and Wildlife Service 1996; Moyle 2002). Severe alterations in the composition and abundance of the primary producer and primary/secondary consumer assemblages in the Delta have been implicated in the recent decline of longfin smelt and other native fish species (U.S. Fish and Wildlife Service 1996; Kimmerer 2002).

Occurrence in Plan Area

Longfin smelt are common in the study area. The Summer Townet survey and Fall Mid Water Trawl survey captured numerous longfin smelt in Suisun, Honker, and Grizzly bays and Montezuma Slough. The 2008 Bay Study otter trawl age-0 longfin smelt index was 1.7 times the 2007 index, an abundance increase similar to the Bay Study Mid Water trawl. Age-0 fish were collected from June through December and abundance peaked in September. They were collected from South Bay through eastern Suisun Bay, but were most common in Central Bay most months (Fish et al. 2009). Larval longfin smelt were captured in 2009 from January to March in the bays and Montezuma Slough (California Department of Fish and Game 2009c).

Longfin smelt are found in Suisun Marsh throughout the year and in all sloughs. Highest numbers of longfin smelt were found in Cutoff, Goodyear, and Suisun Sloughs (Bay Delta and Tributaries no date) (Figure 5.6-3). They are prevalent from January to May and September to December (Table 6.1-4). Smaller numbers occur from June to August. In 2005, longfin smelt numbers were the lowest since 1998, and the eighth lowest since 1980. The Fall Midwater Trawl conducted by DFG and the Bay Study shows similar declines. It is unknown why longfin smelt numbers declined in 2005 because environmental parameters were suitable (Schroeter et al. 2006:9).

Green Sturgeon

Green sturgeon are federally listed as threatened. Critical habitat was designated for green sturgeon in Suisun Marsh on October 9, 2009 (74 FR 52300). Although green sturgeon are anadromous, they are the most marine-oriented species of sturgeon and are found in nearshore marine waters from Mexico to the Bering Sea (70 FR 17386). In fresh water, green sturgeon occur in the lower reaches of large rivers from British Columbia south to San Francisco Bay. The southernmost spawning population of green sturgeon occurs in the Sacramento River system (Moyle 2002).

Green sturgeon have been divided into two distinct population segments: the northern and southern distinct population segments. The Northern DPS and Southern DPS are distinguished based on genetic data and spawning locations, but their distribution outside of natal waters generally overlap with one another (Lindley et al. 2008). The northern distinct population segment consists of green sturgeon populations extending from the Eel River northward, and the southern distinct population segment includes populations extending from south of the Eel River to the Sacramento River. Spawning populations have been confirmed, however, only in the Rogue (Oregon), Klamath, and Sacramento rivers (70 FR 17386). In the Central Valley, spawning occurs in the Sacramento River upstream of Hamilton City, perhaps as far upstream as Keswick Dam (Adams et al. 2002), and possibly in the lower Feather River (Moyle 2002).

Adults migrate upstream into rivers between late February and late July, and spawn between March and July, when the water temperature is 46–57°F. Peak spawning occurs from mid-April to mid-June (Table 6.1-4). After hatching, young green sturgeon rear for several months in the Sacramento River as they migrate downstream from spawning areas. Trapping records indicate that larvae and juveniles spend the first 1 to 2 months in the Sacramento River between Hamilton City and Keswick Dam (National Marine Fisheries Service 2008). Laboratory studies of migration, foraging, and wintering behavior of green sturgeon from the Klamath River (Kynard et al. 2005) indicate that larvae and juveniles are strongly bottom-oriented and migrate downstream at night, remaining in the river downstream of spawning areas through their first winter. At 7 months of age, juvenile sturgeon are able to survive 32 ppt salinity (Allen et al. 2003). At all ages they are able to tolerate a wide range of salinities (Table 6.1-5).

Little is known about the movements and habits of green sturgeon. Green sturgeon have been salvaged at the state and federal fish collection facilities in every month, indicating that they are present in the Delta year-round. Between January 1993 and February 2003, a total of 99 green sturgeon were salvaged at the state and federal fish salvage facilities; no green sturgeon were salvaged in 2004 or 2005. Although it is assumed that green sturgeon are present throughout the Delta and rivers during any time of the year, salvage numbers probably indicate that their abundance is low. The diet of adult green sturgeon seems to be mostly benthic invertebrates and small fish (Ganssle 1966). Juveniles in the Delta feed on opossum shrimp and amphipods (Radtke 1966).

Occurrence in Plan Area

Six green sturgeon have been captured during the Fall Mid Water Trawl surveys in Suisun Bay. Three green sturgeon have been captured during the UC Davis Suisun Marsh fish survey. Two were caught in March 1998 and one in April 1996. Two were caught in Suisun Slough below Cordelia Slough, and the other was caught in Montezuma Slough at the boat ramp (Bay Delta and Tributaries no date) (Figure 5.6-3). All three sturgeon were longer than 300 mm, indicating they were at the end of their first year (70 FR 17386) and may have been migrating out to the ocean (Table 6.1-4). Because no other green sturgeon have been captured in Suisun Marsh since 1998, it is hard to determine how many sturgeon use the Marsh.

Delta Smelt

Delta smelt are listed as threatened under ESA and endangered under CESA (January 20, 2010). They are currently in review by the USFWS to be uplisted as endangered. Critical habitat is designated from the Delta into the Sacramento River. Their range extends from San Pablo Bay upstream to Verona on the Sacramento River and Mossdale on the San Joaquin River, encompassing the Delta.

The delta smelt life cycle is completed within the freshwater and brackish low salinity zone (LSZ) of the Bay-Delta. Delta smelt are moderately euryhaline (Moyle 2002). However, salinity requirements vary by life stage (Table 6.1-5). Delta smelt are a pelagic species, inhabiting open waters away from the bottom and shore-associated structural features (Nobriga and Herbold 2008). Although delta smelt spawning has never been observed in the wild, clues from the spawning behavior of related osmerids suggests delta smelt use bottom substrate and nearshore features during spawning. However, apart from spawning and egg-embryo development, the distribution and movements of all life stages are influenced by transport processes associated with water flows in the estuary, which also affect the quality and location of suitable open water habitat (Dege and Brown 2004; Feyrer et al. 2007; Nobriga et al. 2008).

Delta smelt are weakly anadromous and undergo a spawning migration from brackish water to freshwater annually (Moyle 2002). In early winter, mature delta smelt migrate from brackish, downstream rearing areas in and around Suisun Bay and the confluence of the Sacramento and San Joaquin rivers upstream to freshwater spawning areas in the Delta. Delta smelt historically have also spawned in the freshwater reaches of Suisun Marsh. In winters featuring high Delta outflow, the spawning range of delta smelt shifts west to include the Napa River (Hobbs et al. 2007).

Delta smelt spawning may occur from mid-winter through spring; most spawning occurs during April through mid-May when water temperatures range from about 12°C to 18°C (Moyle 2002). Spawning occurs primarily in sloughs and shallow edge areas in the Delta. Delta smelt spawning has also been recorded in Suisun Marsh and the Napa River (Moyle 2002). Most adult delta smelt die after spawning (Moyle 2002). However, some fraction of the population may hold over as two-year-old fish and spawn in the subsequent year. Most of what is known about delta smelt spawning habitat in the wild is inferred from the location of spent females and young larvae captured in the Summer Kodiak trawl (SKT) and 20-mm survey, respectively.

During and after a variable period of larval development, the young fish migrate downstream until they reach the LSZ (indexed as X2) where they reside until the following winter (Moyle 2002). Young-of-the-year delta smelt rear in the LSZ from late spring through fall and early winter. The location of the delta smelt population follows changes in the location of the LSZ which depends primarily on Delta outflow.

At all life stages, delta smelt are found in greatest abundance in the water column and usually not in close association with the shoreline. They inhabit open, surface waters of the Delta and Suisun Bay, where they presumably aggregate in loose schools where conditions are favorable (Moyle 2002). In years of moderate to high Delta outflow (above normal to wet water years), delta smelt larvae are abundant in the Napa River, Suisun Bay and Montezuma Slough, but the degree to which these larvae are produced by locally spawning fish and are transported by tidal currents to the Bay and Marsh is uncertain.

Delta smelt seem to prefer water with high turbidity, based on a negative correlation between the frequency of delta smelt occurrence in survey trawls during summer, fall, and early winter and water clarity. For example, the likelihood of delta smelt occurrence in trawls at a given sampling station decreases with increasing Secchi depth at the stations (Feyrer et al. 2007; Nobriga et al. 2008). This is very consistent with behavioral observations of captive delta smelt (Nobriga and Herbold 2008). The delta smelt's preference for turbid water may be related to increased foraging efficiency (Baskerville-Bridges et al. 2004) and reduced risk of predation.

Temperature also affects delta smelt distribution. Swanson and Cech (1995) and Swanson et al. (2000) indicate delta smelt tolerate temperatures (<8°C to >25°C), however warmer water temperatures >25°C restrict their distribution more than colder water temperatures (Nobriga and Herbold 2008). Delta smelt of all sizes are found in the main channels of the Delta and Suisun Marsh and the open waters of Suisun Bay where the waters are well oxygenated and temperatures are usually less than 25°C in summer (Nobriga et al. 2008).

Occurrence in Plan Area

Suisun Marsh is a key habitat area for delta smelt. Mature adults and rearing juveniles have been detected in Suisun Marsh during all of the past 7 years of DFG Spring Kodiak surveys (California Department of Fish and Game 2008: <http://www.delta.dfg.ca.gov/data/skt/>). Larval delta smelt surveys (20-mm Survey) also are done by DFG and have taken place from 1995 to 2008. Larval delta smelt have been found every year, and numbers vary from year to year (California Department of Fish and Game 2008). Numerous delta smelt have been captured over the years during the UC Davis Suisun Marsh fish survey. However, their numbers have diminished over the years. The highest number caught was 230 fish in 1981, and in subsequent years (1982–2005), numbers ranged from 0 to 33 fish. In 2006, two fish were captured (Schroeter 2008 pers. comm.). They are present in most sloughs in the Marsh, with Suisun Slough having the most fish (Figure 5.6-3). Most adult and juvenile fish rear from January through May and September through December. There are few fish from June through August. Larval smelt are present in the plan area from February to May (Bay Delta and Tributaries no date) (Table 6.1-4).

Sacramento Splittail

Sacramento splittail was listed as a federally threatened species, but was delisted September 22, 2003. Adult splittail migrate from Suisun Bay and the Delta to upstream spawning habitat in the San Joaquin, Sacramento, lower American, and lower Feather rivers (Moyle 2002: 147) during December through March (Table 6.1-4). Surveys conducted indicate the Yolo and Sutter Bypasses provide important spawning habitat (Sommer et al. 1997). Both male and female splittail become sexually mature by their second winter at about 3.9 inches (10 cm) in length. Female splittail are capable of producing more than 100,000 eggs per year (Daniels and Moyle 1983). Adhesive eggs are deposited over flooded terrestrial or aquatic vegetation when water temperature is between 48 and 68°F (8.9 and 20°C) (Moyle 2002; Wang 1986). Splittail spawn in late April and May in Suisun Marsh and between early March and May in the upper Delta and lower reaches and flood bypasses of the Sacramento and San Joaquin rivers (Moyle et al. 2004). Spawning has been observed to occur as early as January and may continue through early July (Table 6.1-4) (Wang 1986; Moyle 2002).

The diet of adults and juveniles includes decayed organic material; earthworms, clams, insect larvae, and other invertebrates; and fish. The mysid *Neomysis mercedis* is a primary prey species, although decayed organic material constitutes a larger percentage of the stomach contents (Daniels and Moyle 1983).

Larval and young-of-the-year splittail are commonly found in shallow, vegetated areas near spawning habitat. Larvae eventually move into deeper and more open-water habitat as they grow and become juveniles. During late winter and spring, young-of- the-year juvenile splittail (i.e., production from spawning in the current year) are found in sloughs, rivers, and Delta channels near spawning habitat. Juvenile splittail gradually move from shallow, nearshore areas to deeper, open-water habitat of Suisun and San Pablo Bays (Wang 1986). In areas upstream of the Delta, juvenile splittail can be expected to be present in the flood bypasses when these areas are inundated during the winter and spring (Jones & Stokes Associates 1993; Sommer et al. 1997). Splittail of all sizes can survive in waters with dissolved oxygen (DO) levels <1 mg/L, allowing them to tolerate slow-moving sections of sloughs (Daniels and Moyle 1983).

Occurrence in Plan Area

Numerous splittail have been captured during the UC Davis Suisun Marsh surveys. Splittail are abundant in late summer when salinities are typically 6 to 10 ppt and temperatures are15 to 23°C (Meng et al. 1994; Meng and Moyle 1995). Adults and juveniles are present year-round in Suisun Marsh (Table 6.1-4) in all sloughs. Most fish were collected in Cutoff, Goodyear, Peytonia, Spring Branch, and Suisun Sloughs (Bay Delta and Tributaries no date) (Figure 5.6-3).

Some splittail have been captured in the Fall Mid Water Trawl surveys in Suisun, Grizzly, and Honker Bays, with most captured In Grizzly Bay and Montezuma Slough. The Bay Study Mid Water Trawl (BSMWT) collected no age-0 splittail in 2008, resulting in 8 consecutive years with very low or 0 indices. The BSMWT did collect 12 older splittail, most from the 2006 year class. Only 1 age-0 splittail was collected in 2008 by the Bay Study Otter Trawl (Fish et al. 2009).

Invertebrates

The benthic invertebrate community provides food for fishes in the shallow-water habitats of the plan area. Suisun Bay is a brackish-water embayment characterized by islands and shallow sub-bays intersected by tide and river - scoured channels. It is inhabited by fewer than 10 permanent benthic macroinvertebrate species because the region is inundated each winter by fresh water. Invertebrates that occur in the Bay include copepods, cladocera, amphipods, polychaete worms (Polychaeta), several marine mollusks, and a freshwater species of clam (*Corbicula fluminea*) when river inflow is unusually high.

The invasion of the clam *C. amurensis* in the late 1980s resulted in a fundamental shift in the benthic community. It is estimated these clams filter an equivalent volume of water equal to the entire North Bay 1-2 times per day (Schroeter et al. 2006); however; the center of distribution of *C. amurensis* and other benthic species varies with flow and the resulting salinity regime. So at any particular location in the estuary, the benthic community can change substantially from year to year as a result of environmental variation and species invasions.

Changes in the benthos can have major effects on food availability to pelagic organisms (Baxter et al. 2008). A consequence of their incredible filtering capacity is thought to be the virtual elimination of the spring phytoplankton bloom (Kimmerer 1998) and the summer/fall chlorophyll bloom as well as a shift from a pelagic food web to a benthic one (Thompson 1998).

CALFED funded a benthic invertebrate study on Suisun Marsh that was implemented by UC Davis (Schroeter, no date). One year (2004) of data was gathered by R. Schroeter. The most abundant components of benthic communities were the overbite clam (*Potamocorbula amurensis*) and several species of segmented worm (Oligochaeta). The overbite clam is an invasive species, and oligochaete worms are common components that provide food for some fish (Brown 2004:59). Both of these components are most abundant in the western Marsh area. Overall, the benthic community sampled is dominated by filterers and collectors (Schroeter, no date).

In addition to samples collected of benthic invertebrate communities in the Marsh, various species of marine shrimp (Caridea) have been caught in otter trawls throughout the sampling years. Five species of caridean shrimp that have been caught are common prey items for fish: *Crangon franciscorum*, *C. nigricauda, C. nigromaculata*, *Heptacarpus stimpsoni*, and *Palaemon macrodactylus*. The most commonly caught species in all years has been *C. franciscorum* and the highest number of shrimp have been captured in Suisun Slough (Schroeter no date). All of the shrimp use the estuary as a rearing area and have different tolerances of salinity. Their populations fluctuate year to year and are dependent on salinity and water temperature (Suisun Ecological Workgroup 2001:130).

The primary source of energy for salmonids in fresh water streams (Chinook salmon and steelhead) is non-biting midge larvae (Chironomidae) and other fly larvae (Diptera) (Merz and Vanicek 1996). Chironomid midges are sensitive to water quality and substrate changes, as well as to disturbance regimes. They are cosmopolitan and ubiquitous, but their abundance in the plan area is unknown. Chironomid colonization and juvenile Chinook salmon foraging have been documented within restored wetlands (Shreffler et al. 1992), suggesting they may occur in the Marsh and are resilient to habitat improvements.

Green and white sturgeon feed on opossum shrimp, amphipods and other benthic invertebrates in the Delta (Radtke 1966; Ganssle 1966). Other native fish prey largely on common and highly abundant species of amphipods (*Corophium* spp.). Euryhaline and estuarine fish such as yellowfin goby, stickleback, starry flounder, and sculpin also prey on these amphipods (Markmann 1986: 37).

Tidal Habitat Use by Fish in the Marsh

Subtidal, low intertidal, low marsh, mid marsh and high marsh all provide habitat for special-status fish species as described below.

Subtidal

Subtidal habitat is primarily open water with some fringing vegetation along the adjacent levees. This habitat is most likely to provide direct benefits to aquatic species such as juvenile Chinook salmon, splittail, striped bass, sturgeon, steelhead, and native resident species such as prickly sculpin, threespine stickleback, starry flounder, and tule perch. These species will derive direct benefits through primary and secondary pelagic production.

Low Intertidal

Low intertidal habitat generally ranges in elevation between subtidal and the lowest edge of vegetation. At this stage, the site is a mix of shallow open water and intertidal mudflats. The mudflats are exposed at low tides and submerged at high tides. Channels have begun to form on the mudflats. As with the subtidal stage, there is likely a fringe of upland vegetation along the existing levees. As with the subtidal, this stage is most likely to provide direct benefits to aquatic species such as juvenile Chinook salmon, splittail, striped bass, sturgeon, and native resident species such as prickly sculpin, threespine stickleback, and tule perch and indirect benefits to delta and longfin smelt from transported phytoplankton from the marshes.

Low Marsh

At this stage, vegetation has colonized and a marsh plain has begun to form. Vegetation likely consists primarily of a narrow set of low marsh such as *Schoenoplectus* species and *Typha* species. A small band of middle marsh vegetation may have established along the upper edges of the site and includes plants such as *Distichlis spicata*, *Sarcocornia pacifica*, *Cuscuta salina*, *and Jaumea carnosa*. Sinuous tidal channels have formed in the marsh plain with vegetated bank edges. Aquatic species such as splittail, striped bass, and resident native species may use the marsh plain when inundated, but are more likely to derive indirect benefits from exported primary and secondary pelagic production (Siegel 2008).

Mid Marsh

At this stage the marsh has evolved to incorporate an area of intertidal mudflats, low marsh, and middle marsh. During high tides the entire marsh plain is flooded, and the only refuge for wildlife is the fringe of upland along the remaining levees. As with low marsh, aquatic species such as splittail, striped bass, and resident native species may use the marsh plain when inundated, but are more likely to derive indirect benefits from exported primary and secondary pelagic production (Siegel 2008).

High Marsh

High marsh ranges from MHHW to the extreme high water line. This elevation provides refuge for wildlife during most tidal cycles, but is occasionally completely inundated. Aquatic species may benefit through increased export of secondary production (terrestrial insects and epibenthic invertebrates) and indirectly through export of organic carbon and nutrients that can support aquatic primary productivity (Siegel 2008).

Table 6.1-6 shows the type of tidal wetland habitat and regions special-status fish species use in Suisun Marsh. Tidal habitat restoration will provide these habitat types as restoration progresses (Figure 2-3).

Table 6.1-6. Special-Status Fish Species in Suisun Marsh and Habitat Use

Species	Tidal Marsh Elevation (low, mid, high)	Region
Chinook salmon	RF (low),RF (mid), RF (high)	All
Steelhead	RF (low)	All
Longfin smelt	RF (low), RF(mid), RF (high)	All
Green sturgeon	RF (low)	1,4
Delta smelt	RFB (low)	All
Sacramento splittail	RFB (low), RFB (mid), RFB (high)	All

Note: R = resting; F = foraging; B = breeding.
Information taken from Goals Project 1999.

Regulatory Setting

Federal

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) establishes a management system for national marine and estuarine fishery resources of commercial importance. This legislation requires that all federal agencies consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect essential fish habitat (EFH). EFH is defined as “waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” The legislation states that migratory routes to and from anadromous fish spawning grounds are considered EFH. The phrase *adversely affect* refers to the creation of any impact that reduces the quality or quantity of EFH. Federal activities that occur outside EFH but that may, nonetheless, have an impact on EFH waters and substrate also must be considered in the consultation process.

Under the Magnuson-Stevens Act, effects on habitat managed under the Pacific Salmon, Coastal Pelagic and Pacific Groundfish Fishery Management Plan also must be considered. The Magnuson-Stevens Act states that consultation regarding EFH should be consolidated, where appropriate, with the interagency consultation, coordination, and environmental review procedures required by other federal statutes such as NEPA, FWCA, CWA, and ESA. Essential fish habitat consultation requirements can be satisfied through concurrent environmental compliance if the lead agency provides NMFS with timely notification of actions that may adversely affect EFH and if the notification meets requirements for EFH assessments. As described in Chapter 1, NMFS is a Principal Agency for development of the SMP and a Cooperating Agency in accordance with NEPA. Additionally, NMFS will issue a BO for the SMP. The SMP BA will provide the required EFH analysis and the mechanism for consultation with NMFS.

Endangered Species Act

ESA is administered by USFWS and NMFS. In general, NMFS is responsible for protecting ESA-listed marine species and anadromous, commercially valuable fishes, whereas other listed species are under USFWS jurisdiction. Section 7 of the ESA is relevant to this plan and is discussed in greater detail in Chapter 10.

Clean Water Act

The federal CWA generally applies to all navigable waters of the United States. However, the CWA is administered in California by the State and Regional Water Boards. The San Francisco Regional Water Board has jurisdiction over Suisun Marsh and Suisun Bay. It issues water quality objectives for protection of beneficial uses of water, including uses of water to maintain fish and wildlife habitats. It also develops and implements its Water Quality Control (Basin) Plan, including total maximum daily load (TMDL) plans for determination of acceptable quantities of specific chemicals and pollutants, such as mercury and selenium. Water temperature also is regulated. The CWA is discussed in greater detail in Chapter 10, and a description of water quality impacts resulting from SMP alternatives is provided in Section 5.2. Information in that section provides information for the determination of impacts on fish related to changes in water quality.

Biological Opinions on the Central Valley Project and State Water Project

The biological opinions written by USFWS and NMFS for CVP and SWP operations discuss the operational effects of the water project on salmonids, steelhead, and sturgeon (National Marine Fisheries Service 2009) and delta smelt (U.S. Fish and Wildlife Service 2008). A discussion in the BOs includes the facilities in Suisun Marsh such as Suisun Marsh Salinity Control Gates, Roaring River Distribution System, Morrow Island Distribution System, and Goodyear Slough Outfall. The SMP plan area includes all of these facilities. Additionally, outflow and export requirements can affect flows and salinities in the Marsh. Additional detail is provided in Chapters, 1, 9, and 10.

State

California Endangered Species Act

The CESA requires take authorization from DFG when a proposed action may take state-listed endangered, threatened, or candidate species. DFG may provide take authorization for otherwise lawful projects when measures to avoid, minimize, fully mitigate, and to ensure adequate funding are provided.

Section 1602 California Fish and Game Code

Section 1602 requires a Streambed Alteration Agreement between DFG and the project applicant to protect resources and is discussed in detail in Chapter 10.

California Endangered Species Act Incidental Take Permit No. 2081-2009-001-03 Issued by California Department of Fish and Game

This permit authorizes take of longfin smelt by DWR in its operation of the SWP in the Delta. Included in the permit are facilities in Suisun Marsh that are operated by DWR: Suisun Marsh Salinity Control Gates, Roaring River Distribution System, Morrow Island Distribution System, and Goodyear Slough Outfall. Additionally, outflow and export requirements can affect flows and salinities in the Marsh. Additional detail is provided in Chapters, 1, 9, and 10.

San Francisco Bay Conservation and Development Commission

The 27-member BCDC was created by the California Legislature in 1965 in response to broad public concern over the future of San Francisco Bay. BCDC's jurisdiction includes Suisun Marsh and open waters, marshes and mudflats of greater San Francisco Bay, including Suisun, San Pablo, Honker, Richardson, San Rafael, San Leandro and Grizzly Bays and the Carquinez Strait.

The commission is charged with regulating all filling and dredging in San Francisco Bay, protecting Suisun Marsh, and other activities associated with San Francisco Bay. A full description of BCDC's authority and responsibilities is discussed in Chapter 10, "Regulatory Framework."

Local

Solano County General Plan

The Solano County General Plan has a separate addendum to the plan called the Suisun Marsh Policy addendum. The addendum specifically discusses the Suisun Marsh area and its resources. The Solano County component of the Suisun Marsh Local Protection Program was certified by the BCDC on November 3, 1982. Specifically, wildlife habitat within Suisun Marsh will be managed and preserved through the following policies (Solano County 2008: Appendix C-2, C-3):

- The diversity of habitats in Suisun Marsh and surrounding upland areas should be preserved and enhanced wherever possible to maintain the unique wildlife resource.
- Suisun Marsh waterways, managed wetlands, tidal marshes, seasonal marshes, and lowland and grasslands are critical habitats for marsh-related wildlife and are essential to the integrity of Suisun Marsh. Therefore, these habitats deserve special protection.
- Where feasible, historical marshes should be returned to wetland status, either as tidal marshes or managed wetlands. If, in the future, some of the managed wetlands are no longer needed for waterfowl hunting, they also should be restored as tidal marshes.

Environmental Consequences

This section describes methods used to analyze potential impacts of the alternatives and mitigation measures to reduce significant impacts to a less-than-significant level.

Assessment Methods

Fish species that occur or have potential to occur in the plan area were presumed to be indirectly affected by implementation of an alternative if the quantity or quality of habitats with which they are typically associated would be affected. Direct impacts on individual species were assessed qualitatively based on the potential sensitivity or susceptibility of the species to disruption as a result of activities that may be associated with implementation of the restoration alternative and managed wetland activities (e.g., dredging, inundation, noise associated with equipment operation). Additionally, impact assessments were based on hydrologic modeling of future site conditions, predicted extent and quality of habitat, and known thresholds for habitat/environmental suitability of these target species.

Significance Criteria

Activities or outcomes associated with the proposed restoration alternatives were identified as having a significant impact on the environment if it would result in:

- substantial reduction in the habitat of a fish species, including a substantial decrease in the acreage or quality of fish habitat;
- a fish population dropping below self-sustaining levels;
- reduction in the number or restriction of the range of an endangered or threatened, or state candidate fish species or species of special concern; or,
- substantial disruption of natural movement corridors.

The following also were considered in determining whether an impact on fish would be significant:

- federal or state legal protection of the resource;
- federal, state, and local agency regulations and policies regarding the resource;
- documented local or regional scarcity and sensitivity of the resource; and
- local and regional distribution and extent of the resource.

An alternative was considered to have a beneficial impact if it would result in a substantial increase in the quantity or quality of aquatic and wetland communities or of habitat for special-status fish species.

Environmental Impacts

No Action Alternative

The No Action Alternative would result in a limited amount of tidal wetland restoration, and some natural breaching may occur. Natural breaching either from levee instability or sea level rise could increase habitat for fish. Currently Suisun Marsh is a disturbed environment that is at least partially limited by a loss of diverse marsh channels because of levees and dikes. Additionally, the operations of some managed wetlands can contribute to seasonal water quality degradation, primarily because of the release of impounded water with low levels of DO and high levels of sulfates. However, it is assumed that the No Action alternative would result in increased limitations on managed wetland operations and maintenance activities, reducing some of the DO issues as a result of reducing flood and drain operations. Levees may not be maintained to the same extent they are currently and, as described above, could result in natural breaching. However, it is expected that most of the levees would stay intact and that the No Action Alternative would result in continued impacts on the species by leaving many of the current habitat-limiting factors in place.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Implementation of Alternative A would result in temporary habitat impacts for special-status fish species in the study area during construction activities. Tidal wetland restoration would occur by breaching and/or lowering exterior levees, resulting in the conversion of managed seasonal wetlands to tidal wetlands and subtidal habitat, depending on the elevations.

The following actions related to tidal wetland restoration could affect special-status fish species in the study area:

- temporary disturbance of fish and their habitats because of construction-related activities;
- temporary impacts to fish habitat because of levee breaching; and
- change in salinity due to breaching locations.

The following sections describe the impacts on special-status species and the associated mitigation measures. The impacts are separated into those resulting from Restoration and from Managed Wetland Activities.

Restoration Impacts

Restoration impacts would occur during activities such as breaching and/or lowering existing exterior levees and upgrading or constructing new exterior levees. Breaching of levees could change water quality (e.g., salinity). Additional tidal wetland within the Marsh would increase the tidal flows throughout Marsh channels and could increase salinity in the channels between Suisun Bay and the new tidal wetlands. The magnitude of the salinity effects would depend on the location (and breach connection) of the new tidal wetlands and the size (acreage) of the new tidal wetlands, but would not be a significant impact. New or upgraded levees would include installation of brush boxes or other biotechnical wave dissipaters to protect the levees from wind and wave erosion. Intertidal habitat such as habitat levees, benches, or berms would also be constructed. Habitat levee design and locations would vary by site but are expected to include widening of existing interior levees by 15 to 30 feet with a gradual slope or the construction of new interior levees or islands.

Impact FISH-1: Construction-Related Temporary Impairment of Fish Survival, Growth, and Reproduction by Accidental Spills or Runoff of Contaminants (Heavy Metals)

Construction activities, such as levee construction and levee breaching would only occur during the in-channel work window of August 1 through November 30, which is during the work window for special-status fish species. These activities accidentally could introduce contaminants into the sloughs in Suisun Marsh and Suisun Bay and could adversely affect special-status fish species and their habitat.

Disturbance of sediment in and around sloughs likely would result in a release of sediments into the slough channels and possibly release of soil contaminants into the water column. Refueling, operating, and storing construction equipment and materials could result in accidental spills of pollutants such as hydraulic fluids, oil, or fuel. Pollutants entering water bodies in the plan area would cause mortality to, and reduced growth of, the egg, larval, and juvenile life stages of fish. Furthermore, these pollutants could adversely affect the movement of special-status species, including juvenile Chinook salmon, steelhead, delta smelt, and green sturgeon. Larval and juvenile delta smelt would not be present during these months because most spawning occurs in the spring. Larger delta smelt, which are present during this time, could avoid adverse conditions.

Environmental commitments, including an erosion and sediment control plan, SWPPP, hazardous materials management plan, spoils disposal plan, and environmental training, will be developed and implemented before and during construction activities (Chapter 2, “Environmental Commitments”). USFWS, NMFS and DFG will be provided these plans for review 30 days prior to construction. Additionally, as described in the Water Quality section, no significant water quality changes are expected to occur during construction and long term changes would be mitigated through design of the breach location and sizes. Compliance with water quality standards and implementation of the erosion control BMPs will ensure that turbidity and suspended sediment levels remain within regulatory limits. Construction activities will be limited to August 1 to November 30 when special-status fish species are generally absent from the Marsh and could avoid adverse effects.

Conclusion: Less than significant. No mitigation required.

Impact FISH-2: Construction-Related Temporary Reduction of Special-Status Fish Rearing Habitat Quality or Quantity through Increased Input and Mobilization of Sediment

Construction activities, such as levee construction, levee breaching, placement of riprap, and dredging, could release sediments into sloughs and Suisun Bay. Once in the stream channel, mobilized sediments can result in direct impacts on resident fishes through gill damage and reduced capacity to take in oxygen. Indirect impacts can include reduced fitness as a result of decreased DO intake ability; increased metabolic costs associated with reduced DO intake ability, and reduced foraging ability as the result of decreased visibility. These activities could adversely affect special-status fish species and their habitat.

Delta smelt, longfin smelt, green sturgeon and Sacramento splittail may occur year-round in the Marsh. As such, all of these species inhabit turbid water during some of their life cycle. There is some evidence that turbidity may be moderately important as cover for juvenile splittail. Juvenile splittail are most abundant in shallow (<2 m deep), turbid waters (Moyle et al. 2004).

Steelhead typically do not use tidal marsh habitat for rearing. In the plan area, juvenile steelhead rear in the fresh water creeks such as Green Valley, Suisun, and Ledgewood Creeks.

Construction activities will be limited to August 1 to November 30. During this time frame most fish are of a larger size and/or less frequent in the Marsh. Chinook salmon and steelhead are uncommon in the Proposed Project area during this time frame.

Environmental commitments, including the erosion and sediment control plan, SWPPP, and environmental training, will be developed and implemented before and during construction activities (Chapter 2, "Environmental Commitments"). USFWS, NMFS and DFG will be provided these plans for review 30 days prior to construction. Additionally, as described in the Water Quality section, no significant water quality changes are expected to occur during construction and long term changes would be mitigated through design of the breach location and sizes. Compliance with water quality standards and implementation of the erosion control BMPs will ensure that turbidity and suspended sediment levels remain within regulatory limits. Therefore, special-status fish species would not likely be affected by short-term increases in turbidity.

Conclusion: Less than significant. No mitigation required.

Impact FISH-3: Short-Term Impairment of Delta Smelt Passage and Reduced Availability of Spawning and Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities

Channel morphology describes the linear, aerial, and volumetric features of a channel, including depth, length, width, and the shape or configuration of the channel (e.g., the characteristics of secondary channels, backwaters, and sloughs). Channel morphology, along with flow, affects stream hydraulics, which refers to a stream's depth, surface elevation, velocity, and turbulence. Together, channel morphology and hydraulics influence the conditions that support fish migration and movement and provide holding, rearing, and spawning habitat. Channel morphology and hydraulics have a major effect on cover and water temperature.

Changes in channel morphology and hydraulics can result when levees are breached and changes in water circulation occur. Depending on the size and location of the breach, the sloughs in Suisun Marsh can be hydraulically affected. These changes are expected to occur for a short time until the newly opened area becomes stabilized, provided that BMPs are implemented. Sediment gradually would fill in the sites, raising elevations and decreasing tidal prism and associated velocities (Figure 2-3).

The majority of larval delta smelt and some juveniles are found in Nurse, Suisun, Cordelia, Denverton, and Spring Branch Sloughs (Bay Delta and Tributaries no date). During high freshwater years, delta smelt may spawn in Suisun Marsh channels (Sweetnam 1999), as seen by the number of larval fish captured. Larvae are planktonic and move with the currents. Aasen (1999:161) found adult and juvenile smelt moved with the tides between Honker and Grizzly Bays.

Levee breaching would occur from August 1 to November 30 when delta smelt larvae and juveniles are larger and can avoid adverse effects in Marsh sloughs. Long-term impacts of velocity changes in the sloughs as a result of levee breaching could preclude delta smelt from rearing habitat depending on the breach location and size. A major change in velocities could have a significant impact on the availability of delta smelt habitat.

Preliminary modeling (Appendix A) suggested that potential project actions under all the alternatives could produce tidal velocities in excess of the sustained swimming speed of several sensitive species (Table 6.1-5). Prior to implementation, preliminary modeling and design of the potential breach areas would be done to assess effects on hydrologic conditions. Velocity changes would be addressed adaptively through modifications of breached areas. Final designs will attempt to account for potential adverse hydrologic modifications. This information will be used to modify or maintain levee breaches as needed to support fish passage and access to rearing habitat for delta smelt. Also, as described in Chapter 2, Environmental Commitments section, any adverse effects on special-status fish species and/or critical habitat, will be addressed by the project proponent, and any additional measures will be followed in compliance with ESA.

As the restored area evolves into a functioning tidal marsh, it is expected to provide indirect benefits through exported pelagic production for delta smelt. Additionally, restoration activities likely would be located throughout the Marsh and implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame. As such, only minimal changes in delta smelt habitat in the Marsh would occur at any one time. For most cases of restoration, adjacent areas would continue to provide suitable habitat in the interim between breaching the levee and a fully functioning tidal marsh.

The overall 30-year plan is expected to benefit delta smelt by encouraging development of a more natural habitat through restoration of managed wetlands to tidal wetlands. Because minor, temporary losses of delta smelt habitat would be compensated for through restoration design and over the long term as the tidal wetland matures, this impact would be less than significant.

Conclusion: Less than significant. No mitigation required.

Impact FISH-4: Short-Term Impairment of Chinook Salmon Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities

Juvenile Chinook salmon were captured in Cutoff, Boynton, Suisun, Montezuma, Nurse, Denverton, and Spring Branch Sloughs. The majority of salmon were captured in Suisun and Montezuma Sloughs, which are wide and deep, and also in Denverton Slough during beach seining (Suisun Ecological Workgroup 2001, Appendix 1:108). Chinook salmon are strong swimmers (Table 6.1-5) compared to delta smelt and can move in and out of higher velocity areas if necessary. However, preliminary modeling suggested that levee breaches in certain locations could result in velocity modifications in excess of the sustained swimming speeds of juvenile salmon and outside NMFS criteria of 2 ft/s for stream velocities with longer fish passageways (National Marine Fisheries Service 2001). The initial analysis suggests that velocity modifications would exceed these criteria only in Hunters Cut (Appendix A).

Prior to implementation, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions. Velocity changes will be addressed adaptively through modifications of breach sizes and locations. Final designs will attempt to account for potential adverse hydrologic modifications. This information will be used to modify or maintain levee breaches as needed to support fish passage and access to rearing habitat for Chinook salmon. Also, as described in Chapter 2, Environmental Commitments section, any adverse effects on special-status fish species, critical habitat, or EFH will be addressed by the project proponent, and any additional measures will be followed in compliance with CESA, ESA, and EFH.

Conclusion: Less than significant. No mitigation required.

Impact FISH-5: Short-Term Impairment of Steelhead Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities

A small population of Central California coast steelhead may migrate up Suisun Slough into Peytonia, Cordelia, and Chadborne Sloughs and ultimately into Suisun, Green Valley and Ledgewood Creeks. Various breach locations were modeled, and changes in velocities only rarely exceeded steelhead capabilities to swim upstream. As discussed above for Chinook salmon, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions. Velocity changes will be addressed adaptively through modifications of breach locations and sizes, and migratory pathways will be maintained. Therefore, it is unlikely steelhead would be affected by restoration activities in the long term.

Conclusion: Less than significant. No mitigation required.

Impact FISH-6: Short-Term Impairment of Green Sturgeon Passage and Reduced Availability of Holding and Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities

Green sturgeon are present in the system year-round. A total of three green sturgeon were captured in 1998 in Montezuma and Suisun Sloughs (Bay Delta and Tributaries no date). Green sturgeon are strong swimmers (Table 6.1-5), and it is unlikely they would be affected by temporary changes in hydraulics. As discussed above for delta smelt, Chinook salmon, and steelhead, velocity changes will be addressed adaptively through preliminary modeling and design and through modifications of breached locations and sizes, and migratory pathways will be maintained.

Conclusion: Less than significant. No mitigation required.

Impact FISH-7: Short-Term Impairment of Sacramento Splittail Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Velocity Attributable to Restoration Activities

Many splittail have been caught throughout the sloughs in Suisun Marsh. Adult splittail are known to swim against strong river and tidal currents (Moyle 2002:147). Sommer et al. (2002) studied adult and juvenile splittail in a model floodplain wetland. Splittail in the 15–20 mm range used shallow edgewater habitat with emergent vegetation. Larger fish used deeper water habitat in open and vegetated areas. Depending on the age and size of splittail in the restoration areas, young splittail are likely to be excluded from edge habitat if velocities are high and vegetation is absent. However, restoration designs will incorporate vegetation on benches and berms (habitat levees or other intertidal habitat), which would provide some rearing habitat and young splittail may also move to more favorable habitat within the Marsh. Adult fish use more open-water habitat and can swim against current. As discussed above for delta smelt, Chinook salmon, and steelhead, velocity changes will be addressed adaptively through preliminary modeling and design and through modifications of breached areas, and migratory pathways will be maintained. They are not likely to be affected by temporary changes in velocities.

Conclusion: Less than significant. No mitigation required.

Impact FISH-8: Short-Term Impairment of Longfin Smelt Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Velocity Attributable to Restoration Activities

Longfin smelt have been caught in all the sloughs in Suisun Marsh (Bay Delta and Tributaries no date). Larval longfin smelt are pelagic and get washed downstream into Suisun Bay during high flows and rear in and near the Bay, depending on the location of X2. Juveniles and adults may move out into the ocean during the summer and fall months, when breaching activities would occur. They would probably be unaffected by temporary changes in velocities. As discussed above for delta smelt, Chinook salmon, and steelhead, velocity changes will be addressed adaptively through preliminary modeling and design and through modifications of breached areas, and migratory pathways will be maintained.

Conclusion: Less than significant. No mitigation required.

Impact FISH-9: Temporary Reduction of Delta Smelt Habitat Quantity or Quality through Removal and Destruction of Cover Attributable to Restoration Activities

Cover describes the physical components of an aquatic environment that provide shelter and hiding, resting, rearing, holding, and feeding areas for fish and other aquatic organisms. Aquatic plants, trees, and large woody debris (e.g., tree limbs, logs, rootwads) provide cover. The quantity and quality of cover for fish and aquatic invertebrates is a primary determinant of habitat availability and suitability for some species during life stages when they are associated with marsh habitat. The occurrence of many aquatic species depends on the size, density, and continuity of suitable cover.

Under the proposed project, cover could be temporarily or permanently removed during levee reconstruction and/or breaching. Levee breaching would affect only small areas, and scouring impacts on aquatic vegetation would be minimal compared to existing and created habitat. If removal of aquatic vegetation or instream woody material from slough channels is necessary in breach locations, this could temporarily remove cover that is an important component of adult spawning and juvenile rearing habitat. However, the restoration designs would include habitat levees or other intertidal habitat that would provide vegetative cover upon breaching, thus offsetting any losses along the slough channel.

Delta smelt critical habitat includes Suisun Marsh. Delta smelt may use tules for spawning, but spawning substrates are still unknown. Delta smelt often use shallow-water habitat for rearing. Adult delta smelt are primarily a pelagic species, so it is unlikely they require the structural complexity provided by the Marsh. However, they may benefit from prey production exported from the Marsh. Delta smelt also may physically enter restoration sites that are of relatively low elevation (early stage of evolution), as such sites are essentially shallow tidal aquatic environments during higher tide stages. The subtidal and low intertidal stages are most likely to provide such habitat.

Additionally, restoration activities likely would be located throughout the Marsh and implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame. As such, only minimal changes in delta smelt habitat in the Marsh would occur at any one time. Adjacent areas would continue to provide suitable habitat in the interim between breaching the levee and a fully functioning tidal marsh.

Conclusion: Less than significant. No mitigation required.

Impact FISH-10: Temporary Reduction of Chinook Salmon Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities

Project activities are not expected to reduce cover for juvenile Chinook salmon. Salmonids are dependent on riparian vegetation and instream woody material for cover when rearing in freshwater areas. Project activities would be outside of the riparian vegetation zone and are located in brackish water areas.

In the brackish water of the Marsh, juvenile Chinook salmon are known to forage in shallow areas with protective cover such as intertidal and subtidal mudflats, marshes, channels, and sloughs. Therefore, it is reasonable to conclude that juveniles would directly use restoration stages, such as subtidal, low intertidal, and low marsh. Mid marsh and high marsh areas likely will increase secondary production in the Marsh, which would benefit juvenile Chinook salmon. Restoration stages that improve marsh connectivity, such as subtidal and low intertidal, could be directly used for Chinook salmon migration and emigration.

Restoration designs would incorporate intertidal habitat such as habitat levees, benches, or berms to establish and promote a range of marsh elevation habitats, including intertidal and mudflats. As the restored area evolves into a functioning tidal marsh, it is expected to provide permanent, sustainable, suitable habitat for juvenile Chinook salmon. Additionally, restoration activities likely would be located throughout the Marsh and implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame. As such, only minimal changes in Chinook salmon habitat in the Marsh would occur at any one time. Adjacent areas would continue to provide suitable habitat in the interim between breaching the levee and a fully functioning tidal marsh.

Conclusion: Less than significant. No mitigation required.

Impact FISH-11: Temporary Reduction of Steelhead Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities

Juvenile steelhead rear in the freshwater creeks such as Suisun, Ledgewood, and Green Valley, located above the plan area. Once juveniles are ready to smolt, they migrate down into Marsh sloughs to move out to the ocean. Smolts may use the Suisun and Honker Bays for rearing, and depending on habitat conditions (water temperature, prey availability) they could move quickly or slowly through the bays (U.S. Bureau of Reclamation 2008). Cover is not anticipated to be removed in Suisun or Honker Bays. Tidal marsh restoration activities in smaller sloughs could affect rearing or migration during the period of time juveniles would be migrating downstream. However, any in-channel work will be conducted in the months that adult and juvenile steelhead are not present. Therefore they would not be affected by disturbance to existing tidal marsh habitat or other cover.

Conclusion: Less than significant. No mitigation required.

Impact FISH-12: Temporary Reduction of Green Sturgeon Habitat Quantity or Quality as a Result of Restoration Activities

Adult and juvenile green sturgeon tend to use deeper water channels during migration and juveniles move nocturnally to avoid predators. Restoration actions would not likely affect migrating sturgeon. However, resulting changes in habitat conditions could have an impact on habitat attributes because of changes in nutrient inputs and benthic communities. Green sturgeon feed primarily on secondary production, such as benthic invertebrates, and as they grow, other species of fish. Restoration stages, such as subtidal, low intertidal, low marsh and mid marsh, likely would increase prey production in the Marsh, which would increase food availability for sturgeon. Because it is thought that sturgeon move from deeper areas to intertidal areas at high tide for foraging, it is reasonable to conclude that green sturgeon would directly use restoration stages, such as subtidal, low intertidal, and low marsh.

Restoration activities would be located throughout the Marsh and implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame. As such, only minimal changes in green sturgeon habitat in the Marsh would occur at any one time. Adjacent areas would continue to provide suitable habitat in the interim between breaching the levee and a fully functioning tidal marsh.

Conclusion: Less than significant. No mitigation required.

Impact FISH-13: Temporary Reduction of Sacramento Splittail Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities

Project activities that remove aquatic vegetation could affect splittail spawning and rearing. Splittail spawn in flooded aquatic vegetation and larvae rear in the same area; however, splittail rarely spawn in Suisun Marsh. Juveniles use shallow open water, sloughs, and channels for rearing. Levee breaching would affect only small areas, and scouring impacts on aquatic vegetation would be minimal compared to existing habitat.

Restoration designs would incorporate intertidal habitat such as habitat levees, benches, or berms to establish and promote a range of marsh elevation habitats, including intertidal and mudflats. As the restored area evolves into a functioning tidal marsh, it is expected to provide permanent, sustainable, suitable habitat for splittail. Additionally, restoration activities likely would be located throughout the Marsh and implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame. As such, only minimal changes in splittail habitat in the Marsh would occur at any one time. Adjacent areas would continue to provide suitable habitat in the interim between breaching the levee and a fully functioning tidal marsh.

Conclusion: Less than significant. No mitigation required.

Impact FISH-14: Temporary Reduction of Longfin Smelt Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities

Longfin smelt are primarily a pelagic species, so it is unlikely they use cover such as aquatic vegetation or other in-water structures provided by the Marsh. Juvenile and sub-adults have been found to be more abundant at sampling locations over deep water (Rosenfield and Baxter 2007).

Conclusion: Less than significant. No mitigation required.

Impact FISH-15: Improved Fish Habitat Due to Increased Dissolved Oxygen Concentrations in Tidal Channels Attributable to Restoration Activities

Restoration activities that convert managed wetlands to tidal wetlands, especially those in areas with poor circulation or other conditions leading to low levels of DO, will promote increased water circulation and decrease the amount of high sulfide water discharged from managed wetlands into sloughs. Sloughs are important habitat for delta smelt, longfin smelt, splittail and other native fish species and DO is an important habitat quality factor. The extent of this improvement depends on the location and design of individual restoration sites. However, it is assumed that at least some areas currently contributing to low DO will be restored, resulting in an improvement in those areas. See Section 5.2, Water Quality, Impact WQ-5, for more details.

Conclusion: Beneficial.

Impact FISH-16: Salinity–Related Reduction of Delta Smelt Survival, Growth, Movement, or Reproduction Attributable to Restoration Activities

The magnitude of the salinity effects would depend on the location (and breach connection) of the new tidal wetlands and the size (acreage) of the new tidal wetlands. Restoration with tidal connection to Suisun Bay or Honker Bay may have the largest salinity effects. The effects would be greatest during periods of low Delta outflow when the Suisun Bay salinity is highest and the salinity gradient within Suisun Bay and along Montezuma Slough is strongest. However, the seasonal magnitude of the salinity in the Marsh would continue to be governed by Delta outflow and operation of the SMSCG.

Changes in salinity as a result of levee breaching could affect special-status fish species, but preliminary modeling results suggest that most salinity changes as a result of project activities would be well within the environmental tolerance for delta smelt (Table 6.1-5) with the highest salinity increase to 15 ppt in different areas of the Marsh. As discussed in Section 5.2, Water Quality, salinity is not expected to change dramatically from existing conditions; therefore restoration actions would not change the availability of delta smelt rearing habitat.

Figures 5.2-7 to 5.2-15 show simulated salinity in selected Marsh channels for the baseline conditions and two representative tidal restoration conditions with about 7,500 acres of new tidal wetlands for 2002 and 2003. Salinity changes in the existing Marsh sloughs would depend on the additional tidal restoration upstream and downstream from the stations, as well as the location within the Marsh. For example, Goodyear Slough (Figure 5.2-13) and Cordelia Slough (Figure 5.2-12) EC would not likely change with additional tidal wetlands restoration in the Marsh because salinity in the western Marsh is strongly controlled by Delta outflow and the corresponding Suisun Bay salinity.

Delta smelt have levels of tolerance that vary among life stages, with juveniles requiring lower levels of salinity than older fish (Table 6.1-5). There is some potential for small-scale hydrologic modifications that could produce a microcline of low salinity, especially where activities isolate freshwater inputs such as the wastewater discharge in Boynton Slough (Figures 5.2-7 to 5.2-15). These modifications would create habitats and habitat types that are suitable for delta smelt spawning. There is potential that those lower salinity zones would attract delta smelt, but not be suitable for spawning because of structural, predator, or other issues. However restoration areas will be modeled to determine the appropriate breach sizes and locations. Salinity changes will be addressed adaptively through modifications of breached areas. Final designs will attempt to account for potential adverse hydrologic modifications. Also, as described in Chapter 2 under Environmental Commitments, any adverse effects on special-status fish species or critical habitat will be addressed by the project proponent, and any additional measures will be followed in compliance with ESA. In general, these issues are expected to be less than significant in both the short and long term.

Conclusion: Less than significant. No mitigation required.

Impact FISH-17: Salinity–Related Reduction of Chinook Salmon Survival, Growth, or Movement as a Result of Restoration Activities

Juvenile Chinook salmon occur in Suisun Marsh during periods of low salinity and water temperature (Schroeter et al. 2006:10), which occur during the winter and spring months. Most juvenile Chinook salmon were captured from January through April (Table 6.1-4). As with delta smelt (FISH-16) there is little or no risk of adverse impacts attributable to water quality or salinity changes associated with restoration activities because of preliminary modeling and design of breach sites. Also, as described in Chapter 2 under Environmental Commitments, site-specific environmental documentation will be completed and any adverse effects on special-status fish species, critical habitat, or EFH will be addressed by the project proponent, and any additional measures will be followed in compliance with CESA, ESA, and EFH.

Conclusion: Less than significant. No mitigation required.

Impact FISH-18: Salinity–Related Reduction of Steelhead Survival, Growth, or Movement as a Result of Restoration Activities

Because so few steelhead have been captured in Suisun Marsh and because substantial changes in salinity are not expected, it is unlikely they would be affected by salinity changes on any significant level. Steelhead are known to have large environmental tolerances to salinity changes, especially during their migrations to and from the ocean. Therefore, even if steelhead were to encounter water quality changes as a result of restoration activities, it is highly unlikely that they would be affected.

Conclusion: Less than significant. No mitigation required.

Impact FISH-19: Salinity–Related Reduction of Green Sturgeon Survival, Growth, or Movement as a Result of Restoration Activities

Salvage and trawling records from the Delta indicate the majority of juveniles in the plan area are likely to be longer than 200 mm or at least 9 or 10 months of age. After 7 months of age, juvenile sturgeon are able to survive up to 32 ppt (pure seawater) (Allen et al. 2003) (Table 6.1-5). Therefore, the salinity tolerance range of green sturgeon is sufficiently large, and their residence in the plan area is sufficiently short, that there is little or no risk to green sturgeon associated with restoration activities. None of the modeled scenarios results in an increase of salinity greater than 15 ppt (Figures 5.2-7 to 5.2-15). As mentioned above, prior to implementation, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions.

Conclusion: Less than significant. No mitigation required.

Impact FISH-20: Salinity–Related Reduction of Sacramento Splittail Survival, Growth, Movement, or Reproduction as a Result of Restoration Activities

Splittail can tolerate a wide range of salinities (Young and Cech 1996) (Table 6.1-5). They are highly mobile swimmers that are not obligate to littoral areas. There is some risk that restoration actions would generate high salinity zones outside of the tolerances of Sacramento splittail; however, preliminary modeling (Appendix A) suggests that this is unlikely. Prior to implementation, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions.

Conclusion: Less than significant. No mitigation required.

Impact FISH-21: Salinity–Related Reduction of Longfin Smelt Survival, Growth, Movement, or Reproduction as a Result of Restoration Activities

Eggs and larvae have low salinity tolerances and would be excluded from restored habitat with salinities outside of their range. Adults and juveniles can survive salinities up to 32 ppt (Table 6.1-5). Longfin smelt typically do not use the plan area to spawn and none of the modeled scenarios results in an increase of salinity greater than 15 ppt (Figures 5.2-7 to 5.2-15). Therefore, there is little or no risk that this taxon would be affected by salinity changes attributable to restoration activities. Prior to implementation, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions.

Conclusion: Less than significant. No mitigation required.

Impact FISH-22: Disturbance, Injury, or Mortality of Individual Fish Resulting from Work Adjacent to Bodies of Water

Disturbance is exhibited as a change in the behavior of an individual organism, such as movement, cessation of feeding, or interruption of reproductive activities. Disturbance can be caused by human activities that generate sufficient noise, light, physical movement, or vibration to change the behavior of individual organisms. Disturbance may alter species' survival if vulnerability to predation is increased or if the disturbance affects growth or reproductive success.

Direct injury and mortality result from physical trauma, which can be caused by direct and indirect contact with humans or machinery. Direct injury may impair fish movement, feeding, and survival. Actions implemented next to streams may disturb fish but are unlikely to result in direct injury or mortality. Disturbance may result from the temporary movement of construction equipment and personnel, use of temporary lighting, grading, and construction of access roads and staging areas. Direct injury and disturbance of fish is most likely to occur during in-water work. Several restoration actions may include in-water work, such as:

- removal and disturbance of aquatic vegetation,
- creation and/or modification of exterior levees, and
- breaching of levees.

The effect of disturbance on fish depends on the sensitivity of the species' life stage and on the duration and frequency of disturbance. Disturbance may reduce feeding, interfere with reproduction, and cause movement from habitat. Movement could result in mortality attributable to predation. Long-term disturbance over a substantial proportion of a species' habitat may reduce species population abundance, distribution, and production.

Disturbance and direct injury would be avoided and minimized through implementation of environmental commitments and BMPs. These BMPs would include focusing instream work on high temperature periods when most special-status fish species are absent from the shallow-water habitat in the plan area (August 1 through November 30).

Conclusion: Less than significant. No mitigation required.

Impact FISH-23: Change in Fish Species Composition Attributable to Changes in Salinity or Water Quality from Managed or Natural Wetland Modifications

The salinity and temperature tolerances of fishes are highly variable. This variability is in part responsible for the diversity of fish communities across micro-scale habitat types in the Delta and Suisun Marsh. Patterns in these habitat affinities are notable across biological taxa, and between endemic versus introduced species (Moyle et al. 1986). In theory, habitat modification as a result of restoration activities could have a negative impact on species composition because of changing water quality conditions. However, preliminary modeling suggests that the resulting salinity conditions would be within the normal range for the plan area (Appendix A), and previously published literature suggests that the habitat types created as a result of restoration activities would be suitable for and beneficial to sensitive fish species resident in Suisun Marsh. Prior to implementation, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions.

Conclusion: Less than significant. No mitigation required.

Impact FISH-24: Change in Benthic Macroinvertebrate Composition Attributable to Changes in Channel Morphology and Hydraulics as a Result of Tidal Restoration

Benthic invertebrate composition could change if channel morphology and hydraulics change as a result of restoration. Higher velocities could occur at certain places in the channel, and if that occurs, the habitat could attract and retain a modified benthic macroinvertebrate community. However, preliminary modeling suggests that the project actions would result in minimal long-term hydrologic modifications (Appendix A) in the system, provided that BMPs are adhered to. The specific mixture and arrangement of particular hydrologic features may be altered, but the resulting conditions should be within the tolerances of the extant benthic macroinvertebrate community. An appropriate level of benthic monitoring or a benthic community evaluation will be conducted associated with the final site-specific breach design and anticipated influence on existing slough channel modifications from the tidal restoration actions, as needed. This monitoring or evaluation will be implemented to determine effects from tidal restoration activities on the macroinvertebrate community, and to ensure that impacts do not exceed the thresholds identified above.

Conclusion: Less than significant. No mitigation required.

Impact FISH-25: Change in Primary Productivity as a Result of Tidal Restoration

The proposed restoration activities would provide increased exchange between marsh, intertidal and subtidal habitat and the sloughs and bays in Suisun Marsh. Algal growth rates are limited by low availability of sunlight energy (Cloern 1999). Light limitation is most severe in deeper channels where algal respiration can balance or exceed photosynthesis. Primary production is highest in shallow water habitats (e.g., Blacklock), inundated floodplains (e.g., Yolo Bypass), and tidal sloughs (Sobczak et al. 2005). Also, fish would have increased access to higher productivity shallow-water areas such as blind channels and marsh channels.

Connectivity between the restoration site and the aquatic environments is important to provide the greatest ecological value. Most of the volume in the larger Suisun Marsh sloughs (e.g., Montezuma Slough, Suisun Slough) is below the photic zone and thus exhibits productivity deficits. When shallow productive habitats are hydrodynamically proximate to deep channel habitats, excess shallow habitat production can support biological production in the channels if hydrodynamic exchanges are optimal (Siegel 2008). Shallow-water marshes can function as donor habitats by exporting unconsumed phytoplankton biomass to support biological production in deep channel habitats (López et al. 2006; Cloern 2007). When the connectivity rate is optimized, production exported from shallow donor habitats subsidizes production in resource deficit habitats like deeper sloughs (Siegel 2008). The open water associated with newly restored areas could provide nutrients and primary productivity that would enhance secondary food web production in adjacent heterotrophic habitats. Habitats that are connected support more species than disconnected ones (Zedler and Callaway 2001).

Therefore, project activities would benefit the actual or available primary productivity of the plan area as a whole by increasing nutrient exchange and nutrient turnover rates. Nutrient levels would increase in an area where water quality is improved. In theory primary production would increase, and zooplankton would respond assuming the system is bottom-up controlled.

Conclusion: Beneficial.

Managed Wetland Activities Impacts

As described in Chapters 1 and 2, many of the managed wetland activities are baseline activities that currently are conducted and will continue under the SMP. As such, any effects of these activities on fish are part of the baseline. The diversion of water as part of managed wetland activities affects a number of fish species, including special-status fish species. Other activities that take place on the interior of levees are not expected to affect water quality or fish species. The management activities that take place on the exterior of levees such as the ones listed below have the potential to disturb the aquatic environment, including special status-fish species:

- Replacing Riprap on Exterior Levees
- Coring of Existing Exterior Levees
- Repairing Exterior Water Control Structures (Gates, Couplers, and Risers)
- Replacing Pipe for Existing Exterior Flood, Drain or Dual-Purpose Gate
- Installing, Repairing, or Re-installing Water Control Bulkheads
- Maintaining, and Repairing, Removing, and Relocating Existing Reclamation and DWR Facilities in the Marsh
- Removing Reclamation and DWR Monitoring Stations
- Installing New Reclamation and DWR Monitoring Stations
- Installing Alternative Bank Protection on Exterior Levees such as Brush Boxes and Biotechnical Wave Dissipaters
- Installing New Fish Screen Facilities
- Repairing Existing Exterior Levees

- Dredging from Tidal Sloughs as Source Material for Exterior Levee Maintenance
- Placing Riprap in New Areas Not Previously Riprapped

Chapter 2 identifies the following environmental commitments for managed wetland activities: restriction of construction times and development and implementation of hazardous spill plan(s). Specifically, in-water work will occur between August 1 and November 30, which avoids most of the special-status fish species. Additionally, most of the managed wetland activities are expected to be implemented from June to September when the wetlands are dry enough to conduct these activities. These environmental commitments are identified below where appropriate to clarify the types of environmental commitments related to managed wetland activities.

Impact FISH-26: Construction-Related Temporary Impairment of Fish Survival, Growth, and Reproduction by Accidental Spills or Runoff of Contaminants (Heavy Metals)

Many of the management activities listed above have the potential to release contaminants into slough channels. As identified in Chapter 2, Environmental Commitments for managed wetland activities will have construction period restrictions, and hazardous materials management plan(s) will be developed and implemented. Management activities would have a limited area of disturbance and shorter duration of management activities than restoration activities. Activities would be limited to August 1 to November 30 when special-status fish species are generally absent from the Marsh and thus would avoid adverse effects. Therefore, the limited area of disturbance, shorter duration, and environmental commitments would eliminate the likelihood of any substantial contaminant input. Contaminants would have a less-than-significant impact on special-status fish species and their habitat in Suisun Marsh because the potential of increased contaminant input is small.

Conclusion: Less than significant. No mitigation required.

Impact FISH-27: Construction-Related Temporary Reduction of Fish Rearing Habitat Quality or Quantity through Increased Input and Mobilization of Sediment

Many of the management activities listed above have the potential to release sediment into slough channels. As explained above, environmental commitments have been developed and will be implemented before and during construction activities (Chapter 2, “Environmental Commitments”). Management activities would have less effect on fish species because of the limited area and shorter duration of management activities than restoration activities. Furthermore, activities will be limited to August 1 to November 30 when special-status fish species are generally absent from the Marsh and would avoid adverse effects. . Sediment would have a less-than-significant impact on special-status fish species and their habitat in Suisun Marsh because the potential for increased sediment input is small.

Conclusion: Less than significant. No mitigation required.

Impact FISH-28: Construction-Related Mortality of Fish from Stranding

During the emergency repair of a breach in an exterior levee, tidal water may enter the managed wetland through the breach and could contain fish that move in with the tide. Once tidal waters recede and the breach is repaired, fish could become stranded behind the levee in the managed wetland and would be subject to a decrease in water quality (low dissolved oxygen levels, high water temperatures) and an increase in avian predation, causing an increase in mortality.

Direct injury and stranding would be minimized through implementation of the environmental commitments and BMP’s. The BMP’s would require that DFG be consulted to determine if fish rescue efforts are needed (Chapter 2, Environmental Commitments section) during or after the levee repair. Additionally, the restoration of tidal wetlands throughout the Marsh and implemented over the 30-year plan would increase fish habitat and benefit fish populations. Therefore, the increase in suitable tidal habitat for fish, including many special-status species, would ensure that this impact is less than significant.

Conclusion: Less than significant. No mitigation required.

Impact FISH-29: Temporary Reduction of Delta Smelt, Chinook Salmon and Steelhead Habitat Quantity or Quality Attributable to Management Activities

Management activities (i.e., dredging, new riprap placement, and fish screen installation) could remove aquatic and/or terrestrial vegetation, substrate, or other cover for special-status fish species in the plan area. Aquatic and other vegetation on slough banks will be avoided. Removal of substrate would remove invertebrates from the area. (See Impact FISH-33 for a more detailed discussion). Placement of new riprap and fish screen installation would be in small areas and of short duration. Adjacent areas would continue to provide habitat, and restoration of tidal wetlands throughout the Marsh would provide additional habitat.

Conclusion: Less than significant. No mitigation required.

Impact FISH-30: Temporary Reduction of Green Sturgeon Habitat Quantity or Quality as a Result of Management Activities

Management activities (i.e., dredging, new riprap placement, and fish screen installation) would disturb both edge and deeper water habitat. Green sturgeon tend to use deeper water channels during migration and shallow water habitat for foraging. As discussed in Chapter 2, dredging would be done in the center of slough channels and limited to once every 3 years in the same location. Dredging would not affect migratory pathways except during the actual dredging. Edge habitats would be temporarily disturbed by new riprap placement and fish screen installation. These activities would be in small areas and of short duration. Adjacent areas would continue to provide suitable rearing and migratory habitat.

Conclusion: Less than significant. No mitigation required.

Impact FISH-31: Temporary Reduction of Sacramento Splittail Habitat Quantity or Quality as a Result of Management Activities

Management activities (i.e., dredging, new riprap placement, and fish screen installation) could disturb aquatic vegetation. Project activities that remove aquatic vegetation could affect splittail spawning and rearing. Splittail spawn in flooded aquatic vegetation and larvae rear in the same area; however, splittail rarely spawn in Suisun Marsh. Juveniles use shallow open water, sloughs, and channels for rearing. Aquatic vegetation will be avoided to the extent feasible and adjacent areas would continue to provide suitable habitat.

Conclusion: Less than significant. No mitigation required.

Impact FISH-32: Temporary Reduction of Longfin Smelt Habitat Quantity or Quality as a Result of Management Activities

Management activities (i.e., dredging, and fish screen installation) would disturb deeper slough habitat. Longfin smelt are primarily a pelagic species and juvenile and sub-adults have been found to be more abundant at sampling locations over deep water (Rosenfield and Baxter 2007). Dredging will be limited to August 1 to November 30 when longfin are rare in the Marsh. Additionally, dredging will be limited each year, and the duration and extent of dredging in any one area is small. Adjacent areas would continue to provide suitable habitat.

Conclusion: Less than significant. No mitigation required.

Impact FISH-33: Reduction in Benthic Macroinvertebrate Abundance as a Result of Dredging

As discussed in Chapter 2 under Dredging from Tidal Sloughs as Source Material for Exterior Levee Maintenance and to Remove Sediment around Fish Screens and Other Areas, dredging would occur no more than once every 3 years in any given location of the Marsh. Dredging activities would be spread throughout the Marsh over time so that the total volume of dredging per year per region will be limited (Table 2-5). Table 6.1-7 below shows percentage of habitat that would be affected per year by dredging.

Dredging around fish screens would be done during low tide to minimize in-water work and minimize turbidity. Dredging would occur in the center of slough channels, adjacent to fish screen structures, and in historical dredger cuts (a small, linear channel area isolated by a vegetated berm from the major and minor slough channels, which was created immediately adjacent to the toe of the exterior levees during original levee construction and previous maintenance dredging events). Aquatic and other vegetation would be avoided.

Table 6.1-7. Total Percent Acres per Year Affected by Dredging

Habitat	Total Acres in Plan Area	Acres/Year Affected for Dredging 100,000 cubic yards	% of Total Area Affected/Year
Minor slough	1,108	7.1	0.6
Major Slough	2,212	5.7	0.2
Bays	22,346	0.8	<0.1
Dredger Cut	151	6.1	4.0

Removal of organisms through dredging, and burying of deposit feeders, suspension/deposit feeders, and suspension feeders would occur in portions of the dredging area. Removal of these organisms through dredging or disposal may cause short-term harm to fish species residing in the dredging area by limiting food resources.

Macroinvertebrate use of specific locations in Suisun Marsh is dependent on salinity, water velocity, and substrate conditions (Markmann 1986). Stable invertebrate communities require stable environmental conditions. Consistent with ecological theory, stable communities of low-mobility, long-lived species are more vulnerable to physical disturbance than short-lived species in changeable environments (National Research Council 2002). In Suisun Marsh, macroinvertebrate densities fluctuate as a result of constantly changing environmental conditions such as salinity and DO. If the natural environment has fluctuating water quality, macroinvertebrates in the habitat are likely to be resilient and dredging and disturbance would have less effect on them (U.S. Army Corps of Engineers 1978). Benthic communities normally subject to wave scour, high turbidity, and sediment redeposition recover in a short amount of time from dredging and sediment disposal because the residents are rapidly reproducing, opportunistic species with short life cycles (Oliver et al. 1977).

Recolonization of sites occurs within months, although sites may be recolonized by opportunistic species which are not normally dominant at the site (U.S. Army Corps of Engineers 1978). After a disturbance, the recovery of benthic assemblages has been shown to follow a predictive succession of community changes (Stages I–III). The disturbance abates over time, and begins with the initial stage (Stage I) of the benthic successional pattern (Carter et al. 2008). The Stage I taxa usually consist of small opportunistic polychaetes or bivalves and are represented by short-lived individuals. The pattern of succession following a disturbance is initially dominated by polychaetes; however over time, Stage II develops at which time the opportunistic taxa from Stage I are replaced by larger, longer-lived and deeper-burrowing species (Bolam and Rees 2003; Stanos and Simon 1980). With continued successional patterns, Stage III occurs. The late-successional Stage III assemblage consists of more diverse species, which are dominated by larger, longer-lived taxa (Bolam and Rees 2003). The current dominant species composition in the Marsh is polychaetes and bivalves (Schroeter, no date) which represent Stage I species. Dredging would remove these taxa, but should be replaced quickly by recolonization in dredged areas. Taxa would not change.

Invertebrates are expected to recolonize dredge locations within months; therefore, potential long-term impacts on fish associated with these activities are expected to be small. Moreover, the areas of dredging and deposition at any one time are small fractions of the total area of Suisun Marsh. Thus, the influx of organisms from the surrounding undisturbed areas can be rapid. Also, because many of the species in Suisun Marsh remain reproductively active for much of the year, they can quickly colonize a newly exposed sediment surface. As a result, benthic invertebrates in Suisun Marsh can be expected to be as resilient as in other estuaries (Boesch et al. 1976).

As discussed under the Environmental Commitments Section in Chapter 2, measures will be implemented to reduce the water quality effects of dredging. As shown in Table 6.1-7, only a very small area of total habitat would be affected annually. The highest percentage of habitat dredged would occur in dredger cuts and a Benthic Monitoring Program will be implemented to ensure that the impacts do not exceed the thresholds identified above. Benthic sampling will occur 30 days prior to dredging and then at specified time intervals after dredging. If the comparison of data collected prior to dredging and after dredging demonstrates that impacts are greater than what is expected, the dredging program will be modified to minimize the impacts to benthic communities.

Conclusion: Less than significant. No mitigation required.

Impact FISH-34: Disturbance, Injury, or Mortality of Delta Smelt Resulting from Dredging

Clamshell or a bucket excavator will be used to excavate channels for material for exterior levee maintenance when needed. The applicants propose that a total of 30 million cubic yards of materials be dredged from major and minor tidal sloughs and bays over the 30-year period.

Dredging is an activity that removes material from the benthic environment and thus would be more likely to affect benthic species. The potential for injury or direct mortality on fish depends on many factors, including: the abundance, swimming ability (which is positively related to size), and behavioral response of species to dredging activities; the total area dredged; the speed at which dredging is conducted; and possibly other factors.

The type of dredging equipment employed also can influence susceptibility of fish to injury or mortality. For example, fish entrainment rates generally have been shown to be greater for hydraulic dredges than for mechanical dredges, because of the strong suction field associated with hydraulic dredges (Nightingale and Simenstad 2001). Hydraulic dredges will not be used for dredging.

Dredging some areas of Suisun Marsh sloughs theoretically could result in direct mortality of rearing delta smelt if individuals are present when these activities occur. Environmental commitments restrict construction to months when delta smelt are rare in the plan area, thereby minimizing or eliminating potential interactions between this species and the dredging activities.

Dredging practices are outlined in Chapter 2 and include environmental commitments to avoid negative habitat modifications of tidal areas. More specifically, dredging would occur during months when special-status fish species are least likely to be negatively affected and in dredger cuts and other areas that have been dredged previously for levee construction and maintenance. Dredging would take place in the center of the channels, therefore avoiding shallow water habitat and aquatic vegetation. Tidally influenced berms represent key habitat for migratory and resident species in the Marsh, and avoiding these areas would minimize the impacts of dredging to a great extent.

Conclusion: Less than significant. No mitigation required.

Impact FISH-35: Disturbance, Injury, or Mortality of Chinook Salmon Resulting from Dredging

Adult fall-run Chinook salmon could be present in the Marsh from August to November 30. Adult salmon would avoid areas of disturbance and because of their large size and swimming abilities could easily avoid dredging areas. Fish generally will avoid areas of high noise when free to do so (Carlson et al. 2001). The number of adult Chinook salmon interacting with the dredging equipment is likely to be very small. Juvenile Chinook salmon are not expected to be in the Marsh during dredging activities. The primary emigration season is during high flows which typically occur from December to April.

Conclusion: Less than significant. No mitigation required.

Impact FISH-36: Disturbance, Injury, or Mortality of Steelhead Resulting from Dredging

Juvenile steelhead may rear and hold in shallow marsh habitat to some extent, although their affinity for these habitat types is much lower than that of fall-run Chinook salmon (Fresh et al. 2004). As with delta smelt (FISH-34), environmental commitments restrict dredging from August 1 to November 30 when steelhead would be at low densities in the plan area.

Conclusion: Less than significant. No mitigation required.

Impact FISH-37: Disturbance, Injury, or Mortality of Green Sturgeon Resulting from Dredging

Green sturgeon are expected to occur during any month of the year in Suisun Marsh. Lack of information on the numbers of green sturgeon in Suisun Marsh makes it difficult to estimate with any certainty the number of green sturgeon that potentially would be injured or killed during dredging activities. However, their susceptibility to injury or mortality may be higher than that of other fish species (e.g., Chinook salmon) because of their strong association with soft bottom substrates.

A clamshell dredge or long-reach excavator would be used in Suisun Marsh. Clamshell dredgers have caused mortality of sturgeon during operation by injuring fish with the bucket (Killgore and Clarke 2009; Bolden 2009). Environmental commitments limit dredging to August 1 to November 30. Adult green sturgeon are found in Suisun Bay from January to July. Information about juvenile movements and habitat use is currently unknown, but juveniles may be in Suisun Bay year round (Israel 2009).

Dredging in Suisun Marsh would occur in slough channels and also in Suisun Bay. If dredging occurs in slough channels where juvenile green sturgeon are rearing, they could become injured or killed by the dredger. However, it is unknown how many juveniles could become harmed. If dredging occurs in Suisun Bay during the months of August 1 to November 30, injury of adults would probably be low. However, as with juveniles, it is unknown how many adults would be present in Suisun Bay at the time of dredging.

Three green sturgeon were captured in 1998 in Montezuma and Suisun Sloughs by the UC Davis Suisun Marsh fish survey (Bay Delta and Tributaries no date). Fifty-six white sturgeon were caught in the UC Davis sampling efforts from 1980 to 2003 (Bay Delta and Tributaries no date). Because of the small number of green sturgeon and the low density of individuals in any given location, it is unlikely they would become injured.

While dredging is expected to have minimal impacts on green sturgeon, an indeterminable number of green sturgeon could be taken as a result of dredging. The increase in suitable habitat for green sturgeon as a result of the restoration component of the SMP would ensure this impact is less than significant.

Conclusion: Less than significant. No mitigation required.

Impact FISH-38: Disturbance, Injury, or Mortality of Sacramento Splittail Resulting from Dredging

Splittail are present year-round in Suisun Marsh. Splittail would use Suisun Marsh for rearing. They rear in shallow water habitats and move into deeper habitats at night (Sommer et al. 2008: 11). Splittail appear to be highly tolerant of a broad range of environmental conditions (Young and Cech 1996) (Table 6.1-5). During dredging, splittail are expected to move away from any areas of disturbance. They are highly motile and not obligate to the dredged areas during the warm summer and early fall months of the instream work window. Therefore, very minimal, if any, interaction between this taxon and the dredging equipment is expected.

Conclusion: Less than significant. No mitigation required.

Impact FISH-39: Disturbance, Injury, or Mortality of Longfin Smelt Resulting from Dredging

Dredging will be done during the months of August to November using a clamshell dredge. Longfin smelt are generally not present in the Marsh during this time. Therefore, minimal, if any interaction between the dredging equipment and longfin smelt is expected.

Conclusion: Less than significant. No mitigation required.

Impact FISH-40: Reduction of Fish Habitat Quantity or Quality Resulting from Installation of New Riprap on Levees

Riprap replaces naturally occurring bank habitat that eroded due to high energy wind driven waves, boat wake damage, and strong tidal currents, which decreases fish habitat. When riprap is placed in or adjacent to channels to prevent erosion, the suitability of fish habitat is often affected by changes in nearshore cover and local hydraulics. Placement of riprap often is preceded by erosion and degradation of vegetation. Riprap creates a "hydraulically efficient" surface along the riprapped bank; reduces hydrodynamic complexity; decreases nearshore roughness; reduces bank erosion which reduces habitat complexity; and impedes vegetation growth (U.S. Fish and Wildlife Service 2000).

New riprap placement would be limited to 2,000 feet on exterior levees over the 30-year plan period. Levees in the marsh total 200 miles. New riprap placement compared to total levee banks available would be small. New riprap placed as part of the managed wetland activities would generally be in areas that cannot accommodate vegetative or other more natural erosion control methods, which are typically in areas of high velocities or wave energy. Most fish species in the plan area would not use edge habitat in high velocity areas. Additionally, restoration activities specified in the SMP include restoring tidal wetlands and marsh habitat, which increases fish habitat value. The net short- and long-term impacts of project activities would result in increased availability of and access to fish habitat that is suitable for special-status fish species in Suisun Marsh. Therefore, no negative impacts associated with the quantity of habitat are expected.

Conclusion: Less than significant. No mitigation required.

Alternative B: Restore 2,000–4,000 Acres

Alternative B would have the same general impacts as Alternative A. However, Alternative B would restore less tidal marsh and implement more managed wetland activities. Restoring less tidal marsh would decrease beneficial habitat for special-status fish species compared to Alternative A. However, the temporary impacts associated with restoration would occur less frequently.

Alternative C: Restore 7,000–9,000 Acres

Alternative C also would have the same general impacts as Alternative A. Alternative C restores more tidal marsh area and implements fewer managed wetland activities. There would be more long-term tidal marsh habitat benefits for special-status fish species compared to Alternative A, but more temporary construction-related impacts.

Section 6.2
Vegetation and Wetlands

Introduction

This section describes the existing environmental conditions and the consequences of implementing the SMP alternatives on vegetation and wetland resources.

The Affected Environment portion of this section describes the current setting of the action area, including a discussion of the Suisun Marsh regions, land cover types that occur in the action area and special-status species that could occur in the action area. The purpose of this information is to establish the existing environmental context against which the reader can understand the environmental changes proposed by the plan. The environmental setting information is intended to be relevant to the subsequent discussion of impacts.

The environmental changes associated with the plan are discussed under Environmental Consequences. The Environmental Consequences portion of this section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary.

Summary of Impacts

Table 6.2-1 presents a summary of the impacts on vegetation and wetlands and mitigation measures that are associated with each plan alternative. See the impact section for each alternative for a detailed discussion of all impacts and mitigation measures.

Table 6.2-1. Summary of Vegetation and Wetlands Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
VEG-1: Short-Term Loss or Degradation of Tidal Wetlands and Tidal Perennial Aquatic Communities in Slough Channels Downstream of Restoration Sites as a Result of Increased Scour	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
VEG-2: Loss or Degradation of Tidal Wetlands Adjacent to Restoration Sites as a Result of Levee Breaching/Grading	A, B, C	Less than significant	None required	–
VEG-3: Loss of Managed Wetlands as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
VEG-4: Loss of Upland Plant Communities and Associated Seasonal Wetland Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
VEG-5: Spread of Noxious Weeds as a Result of Restoration Construction	A, B, C	Less than significant	None required	–
VEG-6: Loss of Special-Status Plants or Suitable Habitat as Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
VEG-7: Degradation of Native Plant Species and Spread of Invasive Plant Species as a Result of Increased Public Access	A, B, C	Less than significant	None required	–
VEG-8: Loss or Degradation of Tidal Native Plant Species and Spread of Invasive Plant Species as a Result of Tidal Muting	A, B, C	Less than significant	None required	–
Managed Wetland Activities Impacts				
VEG-9: Loss of Special-Status Plants or Suitable Habitat as Result of Exterior Levee Activities	A, B, C	Less than significant	None required	–
VEG-10: Loss or Degradation of Wetland Communities and Special-Status Plant Species in Slough Channels as a Result of Channel Dredging	A, B, C	Less than significant	None required	–
VEG-1: Loss or Degradation of Rare Natural Communities and Special-Status Plant Species as a Result of New Fish Screen Facilities	A, B, C	Less than significant	None required	–
VEG-12: Loss or Disturbance of Managed Wetlands as a Result of Activities within Managed Wetlands	A, B, C	Less than significant	None required	–
VEG-13: Loss or Disturbance of Tidal Wetlands or Other Waters of the United States and Special-Status Plant Species as a Result of Placement of New Riprap and Alternative Bank Protection Methods	A, B, C	Less than Significant	None required	–
VEG-14: Loss or Disturbance of Wetlands and Special-Status Plant Species as a Result of DWR/Reclamation Facility Maintenance Activities	A, B, C	Less than significant	None required	–
VEG-15: Introduction or Spread of Noxious Weeds as Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–

Affected Environment

Definition of Study Area

The study area, as defined for this chapter, includes the four Suisun Marsh regions (Figure 1-3). All of the Marsh could be subject to the SMP, either through restoration actions or implementation of managed wetland activities.

Sources of Information

The following sections describe the information used to prepare the affected environment section for vegetation and wetlands:

- previous studies conducted in the study area,
- published literature,
- Draft Suisun Marsh Tidal Marsh and Aquatic Habitats Conceptual Model (2010)
- California Natural Diversity Database (CNDDB) records search (California Natural Diversity Database 2010), and
- USFWS species lists (U.S. Fish and Wildlife Service 2010).
- Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California (U.S. Fish and Wildlife Service 2010).

Environmental Conditions

The study area consists of a mosaic of tidally influenced bays and sloughs, tidal marsh, managed wetlands, and uplands (Table 6.2-2). Managed wetlands compose approximately 50% of the total acreage in the study area. Bays and sloughs (26%), tidal wetlands (7.5%), and upland (16%) are the other significant land cover types in the study area (Figure 6.2-1). Freshwater streams, seasonal wetlands, and riparian habitat also occur in the study area but compose only a small percentage of the overall area.

The sections that follow describe:

- the Suisun Marsh regions;
- existing land cover types, including wetlands; and
- special-status plant species.

Suisun Marsh Regions

The Suisun Marsh study area consists of 102,142 acres of wildlife habitats which is divided into four regions. These four regions consist of 77, 584 acres of terrestrial and aquatic habitats and 24,558 acres of bays and major sloughs (Table 6.2-2). As described in Chapter 2, the regions were developed to ensure that restoration activities are distributed throughout the Marsh. The acreage for each of the four regions and for each habitat type was calculated by using the most recent geographic information system (GIS) layers from:

- 1999 and 2003 DFG vegetation maps and associated files,
- interpretation of the 2003 aerial photos of the Marsh,
- 2003 SRCD property map, and
- San Francisco Estuary Institute 1998 EcoAtlas.

Table 6.2-2. Suisun Marsh Acreage by Habitat Type and Region

Habitat	Region 1	Region 2	Region 3	Region 4	Total
Tidal	2,046	1,981	704	2,940	7,672
Diked managed wetlands and uplands	12,343	7,503	2,824	29,442	52,112
Minor sloughs[2]	479	234	295	101	1,108
Developed[3]	133	147	14	18	312
Riparian	26				26
Upland[4]	3,157	6,543	3,042	3,610	16,354
Suisun Slough					913
Montezuma Slough					1,299
Bays (including Little Honker)[5]					22,346
TOTAL acres	18,184	16,408	6,880	36,112	**102,142**

Source: California Department of Fish and Game, January 16, 2008.

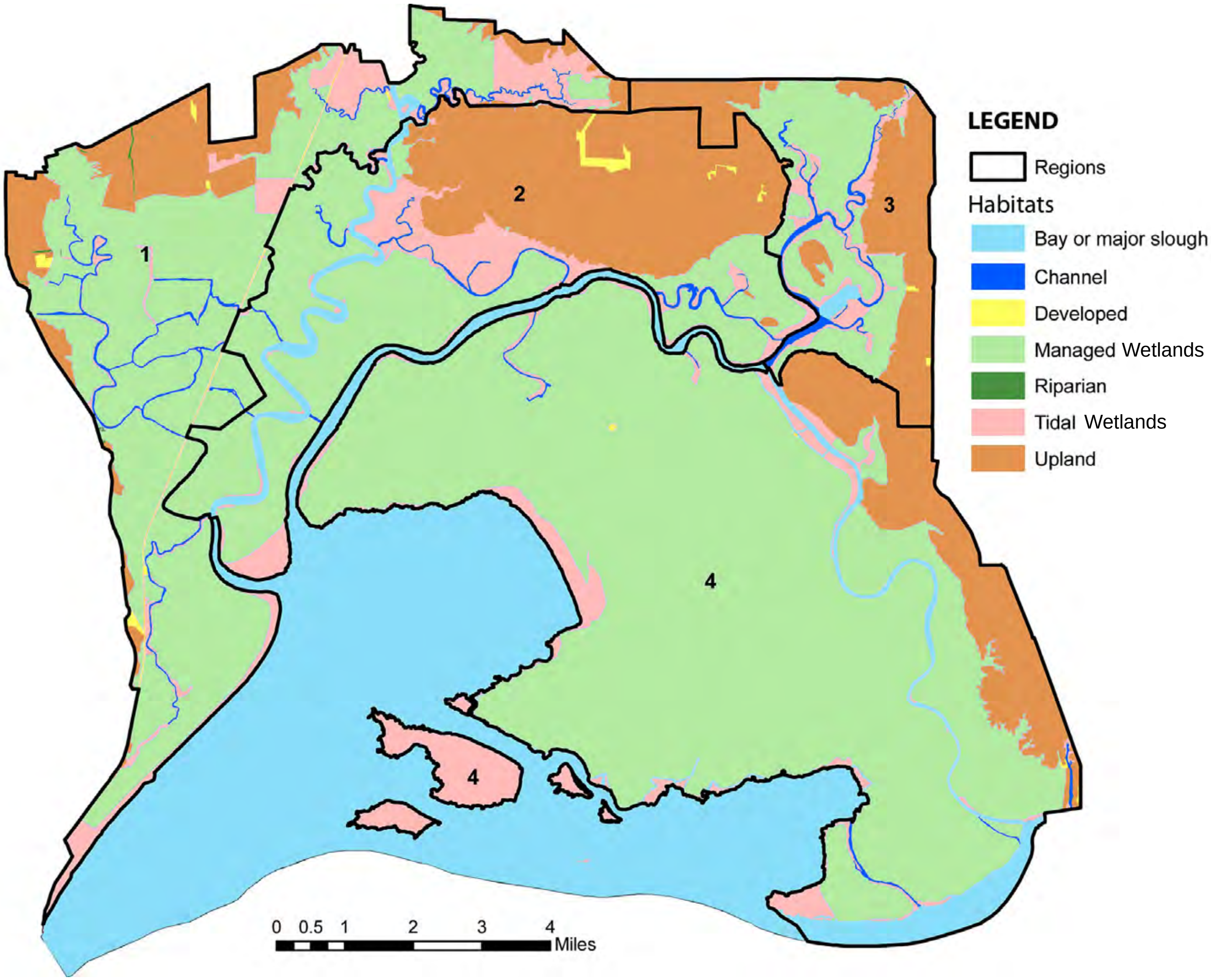
1 Acreages based on the map of regions provided by SRCD and with data layers primarily from San Francisco Estuary Institute (SFEI). 1998. EcoAtlas: Spatial analysis of the baylands ecosystem. Version 1.50b4, as well as the following sources:
- 1999 and 2003 DFG vegetation maps and associated files
- Interpretation of the 2003 aerial photos of Suisun Marsh
- 2003 property line map

2 Includes all tidal sloughs except Montezuma and Suisun Sloughs.

3 Parking lots, major structures (excludes most homes and clubhouses), railroads, etc.

4 Above tidal inundation. Includes Potrero Hills, Kirby Hill, and acreage on the east and northwest edges of Suisun Marsh.

5 Includes Suisun and Honker Bays to the county line and Little Honker Bay.



Source: California Department of Fish and Game.

Graphics/Projects/project number/document (date) SS

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Figure 6.2-1
Regions and Habitats in Suisun Marsh

Bays and Major Sloughs

Bays and major sloughs compose approximately 25% of the total acreage in the study area (Table 6.2-2). Bays in the study area are the portions of Suisun and Honker Bays north of the Contra Costa County line, Grizzly Bay, and Little Honker Bay. The major sloughs in the study area are Suisun and Montezuma Sloughs.

Region 1

Region 1 is predominantly privately owned, and the primary land use is private duck clubs. Several management units of the Grizzly Island Wildlife Management Area are in this region as are the Peytonia Slough Ecological Preserve and the Hill Slough Wildlife Management Area.

The 18,051 acres of terrestrial and aquatic habitat in Region 1 represent approximately 23% of the total land area in the study area. Managed wetlands and tidal wetlands account for 67% and 12%, respectively, of the land cover in this region. Managed wetlands divert and drain water into medium to small tidal sloughs that characterize this area of the Marsh, including Cordelia Slough, Goodyear Slough (GYS), and Wells Slough. Some of these tidal sloughs are influenced significantly by freshwater inflow from the Green Valley, Suisun, and Ledgewood Creeks. The Morrow Island Distribution System is also located in this region. The system allows the adjacent managed wetlands to receive less saline water from GYS and drain into Suisun Slough and Grizzly Bay. Additionally, there are several dead-end sloughs in this region of the Marsh in which tidal exchange is minimal.

Region 2

Region 2 consists of private and public lands, including the Potrero Hills in the northeast portion of this region and managed wetlands in the south and western portions of the region. The Joice Island management unit of the Grizzly Island Wildlife Management Area is in this region. The 16,261 acres of terrestrial and aquatic habitat in Region 2 represent approximately 21% of the total land area in the study area. Managed wetlands and tidal wetlands account for 45% and 12% of the land cover in this region, respectively. Upland habitat, consisting primarily of the Potrero Hills, composes approximately 41% of the total acreage in this region. The Potrero Hills are used for ranching, a landfill facility, and other private uses. A wastewater discharge facility provides a freshwater input source in this region on Boynton and Peytonia Sloughs.

This region of the Marsh is characterized as managed wetland areas that flood off of a small tidal slough, but drain primarily into Suisun Slough, the second largest tidal slough in the Marsh, or Montezuma Slough (the largest tidal slough). Suisun Slough is similar to Montezuma, as a large, highly energetic channel terminating at Grizzly Bay running north into the interior heart of the Marsh. Rush Ranch, the largest remnant tidal wetland in the Marsh, also is located in Region 2. A wastewater discharge facility provides a freshwater input source in this region.

Region 3

Region 3, at 6,880 acres, is the smallest region in the Marsh (6.5% of total marsh area) and consists of private lands. Managed wetlands are the primary land use in the south and western portions of the region, and rangeland is the primary land use to the east as the region transitions into the Montezuma Hills.

Managed wetlands and tidal wetlands account for approximately 45% and 10%, respectively, of the land cover in this region. Upland habitat, consisting primarily of the Kirby Hills and the transition zone to the Montezuma Hills, account for approximately 45% of the land surface area. Bays and sloughs in this region are Little Honker Bay and Nurse, Denverton, and Luco Sloughs. Managed wetland units flood and drain primarily into fairly large to medium-sized tidal sloughs and Little Honker Bay in this area of the Marsh.

Region 4

Region 4 represents the largest geographic region of the Marsh. The 36,094 acres in this region make up approximately 47% of the terrestrial and aquatic habitat in the study area. Managed wetlands and tidal wetlands account for 80% and 8%, respectively, of the land cover in this region.

This region includes Grizzly, Van Sickle, Hammond, Simmons, Chipps, and Wheeler Islands. Montezuma Slough, the Sacramento and San Joaquin Rivers, and Grizzly, Suisun, and Honker Bays hydrologically dominate this area. All of these channel and bays are highly energetic with enormous daily movements of water driven by tides, Delta outflow, wind, and the SMSCG.

This region of the Marsh has had significant investment in fish-screened facilities over the last 15 years, with diversions to about 20,000 acres of managed wetlands screened. The presence of numerous fish-screened facilities, including the RRDS, has changed the management strategies of these managed wetlands. Almost all of these wetland areas obtain their water from Montezuma Slough and drain to the bays if physically possible. If not, the wetland areas drain directly into the large tidal sloughs.

Land Cover Types

History of Change of Land Cover Types

Suisun Marsh is a dynamic tidal wetland system that has been evolving since the last ice age. This process has been accelerated and modified over the last 300 years as a result of anthropogenic changes. As a result of these changes only 5–10% of the historic tidal wetland acreage remains and the functions and values have decreased for much of the remaining acreage for tidal wetland-dependent plant and wildlife species.

Prior to human management, Suisun Marsh consisted primarily of a mosaic of bays and tidal sloughs, tidal marsh, upland transitional zones, and grasslands. The Marsh, bays, and sloughs were subject to daily tidal fluctuations and seasonal variations in water surface level and quality resulting from inflows from the Sacramento and San Joaquin River systems.

Anthropogenic changes have affected the Marsh beginning with the use of fire by Native Americans to control the vegetation cover types. The Suisun Marsh landscape began to transform in the 1700s when Spanish settlers introduced nonnative plants. Fire, which had been used by the Native Americans, continued to be used to manage vegetation communities (California Department of Water Resources 2001).

In the mid- to late 1800s hydraulic mining on Central Valley rivers resulted in the discharge of substantially large sediment loads into valley rivers and eventually the Suisun Bay estuary. Sediment deposition provided additional substrate for tidal wetland development. However, during this time period dike construction was also implemented in Suisun Marsh to convert tidal wetlands to agricultural land.

The most significant changes that have affected the Marsh are the construction of dikes and ditches, the conversion of tidal wetland habitat to agriculture and later managed wetlands, sedimentation associated with hydraulic mining and other land uses that resulted in soil erosion, and the management of seasonal water inflow from Central Valley river systems, including through the operation of the Initial Facilities as described in Section 5.1. In the late 1870–1880s Grizzly Island was leveed and by the 1930s approximately 90% of the original tidal wetlands had been leveed and converted to agricultural lands or other land uses. The last tidal wetlands were leveed in the 1960s–1970s (California Department of Water Resources 2001).

Existing Land Cover Types

A land cover type represents the dominant features of the land surface and can be defined by natural vegetation, water, or human uses. As a result of the Suisun Marsh Preservation Act of 1977 a Plan of Protection was developed to survey and record vegetation communities in Suisun Marsh. The Plan of Protection required triennial vegetation surveys to document overall vegetation composition of Suisun Marsh and to monitor salt marsh harvest mouse habitat. Initial surveys were conducted in 1981, 1988, 1991, and 1994 (California Department of Fish and Game 2000). The survey methods were revised and approved in July 1997.

DFG conducted subsequent vegetation surveys and aerial photograph assessments in 1999 and 2000 (California Department of Fish and Game 2001) and 2003 (California Department of Fish and Game 2004).Additional information on land cover types was reviewed in documents previously prepared for the Suisun Marsh region (California Department of Water Resources 2001). The Suisun Marsh Tidal Marsh and Aquatic Habitat Conceptual Model (Conceptual Model 2010) were also reviewed.

Land cover types in the study area have been mapped and defined for numerous studies and documents. As a result, the definitions of the various land cover types vary slightly. For the purpose of this document, the land cover types will be identified by DFG (California Department of Fish and Game 2008). Waters of the United States have not been formally delineated as part of this plan. Waters of the United States, including wetlands that are expected to fall under the jurisdiction of the Corps are bays and sloughs, tidal wetlands, and managed wetlands are expected to include a majority of the plan area. All of the managed wetlands are considered jurisdictional, and work in these areas is typically permitted by the Corps through RGP 3, as described in Chapter 1. As specific restoration projects are proposed, the project proponent will delineate wetlands in the project area.

In the study area, land cover types can be divided into natural vegetation communities, managed vegetation communities, aquatic communities, and developed land. The land cover types mapped in the study area are listed in Table 6.2-2 and are discussed below. Table 6.2-2 also includes the extent of each land cover type as mapped throughout the study area.

Bays and Sloughs

Bays and sloughs, as defined for this plan, include all areas of tidally influenced open water. Bays and sloughs compose approximately 25% of the total acreage in the study area (Table 6.2-2). Bays in the study area are the portions of Suisun and Honker Bay north of the Contra Costa County line, Grizzly Bay, and Little Honker Bay (Figure 5.6-3). Major sloughs in the study area are Suisun and Montezuma Sloughs. Minor sloughs are smaller channels that are hydrologically connected to the bays and major sloughs.

Tidal sloughs within tidal marshes perform two fundamental functions. First, tidal sloughs are the conduits through which water, sediment, nutrients, and aquatic organisms circulate into, around, and out of the marsh, providing a critical connectivity mechanism between marsh plain and open water environments. Second, tidal sloughs provide essential habitat for a wide variety of fish and wildlife species. Tidal slough edges provide habitat for common and special-status wildlife, fish, and plant species. Tidal sloughs provide shallow water habitat for waterfowl (Conceptual Model 2010).

Bays and sloughs are considered tidal perennial aquatic habitat. Tidal perennial aquatic habitat is characterized by open water and is defined as deepwater aquatic (more than 3 meters [10 feet] deep from mean low tide), shallow aquatic (less than or equal to 3 meters [10 feet] deep from mean low tide), and unvegetated intertidal (tidal flats) zones of estuarine bays, river channels, and sloughs (CALFED Bay-Delta Program 2000). The substrate of the bays and sloughs is primarily mud. Deep open-water areas are largely unvegetated, and beds of intertidal plants may occur in shallower open-water areas. Bays and sloughs are jurisdictional waters of the United States under Section 404 of the CWA and the Rivers and Harbors Act.

No special-status plants are known to occur in the open-water portions of bays and sloughs in the study area. Special-status plants that may occur in the tidal wetlands that border the bays and sloughs are assessed under tidal wetland or other land cover types.

Bays and sloughs and associated tidal wetlands may provide suitable habitat for *Microcystis aeruginosa*, a harmful cyanobacteria known to occur in the Delta, Suisun Bay, San Francisco Bay, and San Pablo Bay. *Microcystis aeruginosa* is not known to occur in the Marsh. This cyanobacterium typically occurs in areas of low salinity and where water mixing is limited. *Microcystis aeruginosa* could occur in the project area under current and proposed conditions; however, no elements of the Proposed Project are expected to change the potential for this cyanobacterium to occur in Suisun Marsh.

Tidal Wetlands

Tidal wetlands are influenced by tidal salt water from San Francisco Bay and an inflow of freshwater from the Delta and smaller local watersheds. Salinity levels vary throughout the year and are influenced largely by inflow from the Delta (Suisun Marsh Ecological Workgroup 2001). Tidal wetlands account for approximately 7,672 acres, or 10%, of the study area. Tidal wetlands are most abundant in Region 4, where they compose 2,940 acres (8.1%) of the land surface. In Regions 1, 2, and 3, tidal wetlands account for 11.6%, 12.2%, and 9.6%, respectively, of the land surface. DFG conducted a habitat monitoring and assessment study of Suisun Marsh vegetation in 1999 (Keeler-Wolf et al. 2000) and performed additional surveys in 2003 to map changes in Marsh vegetation (California Department of Fish and Game 2004).

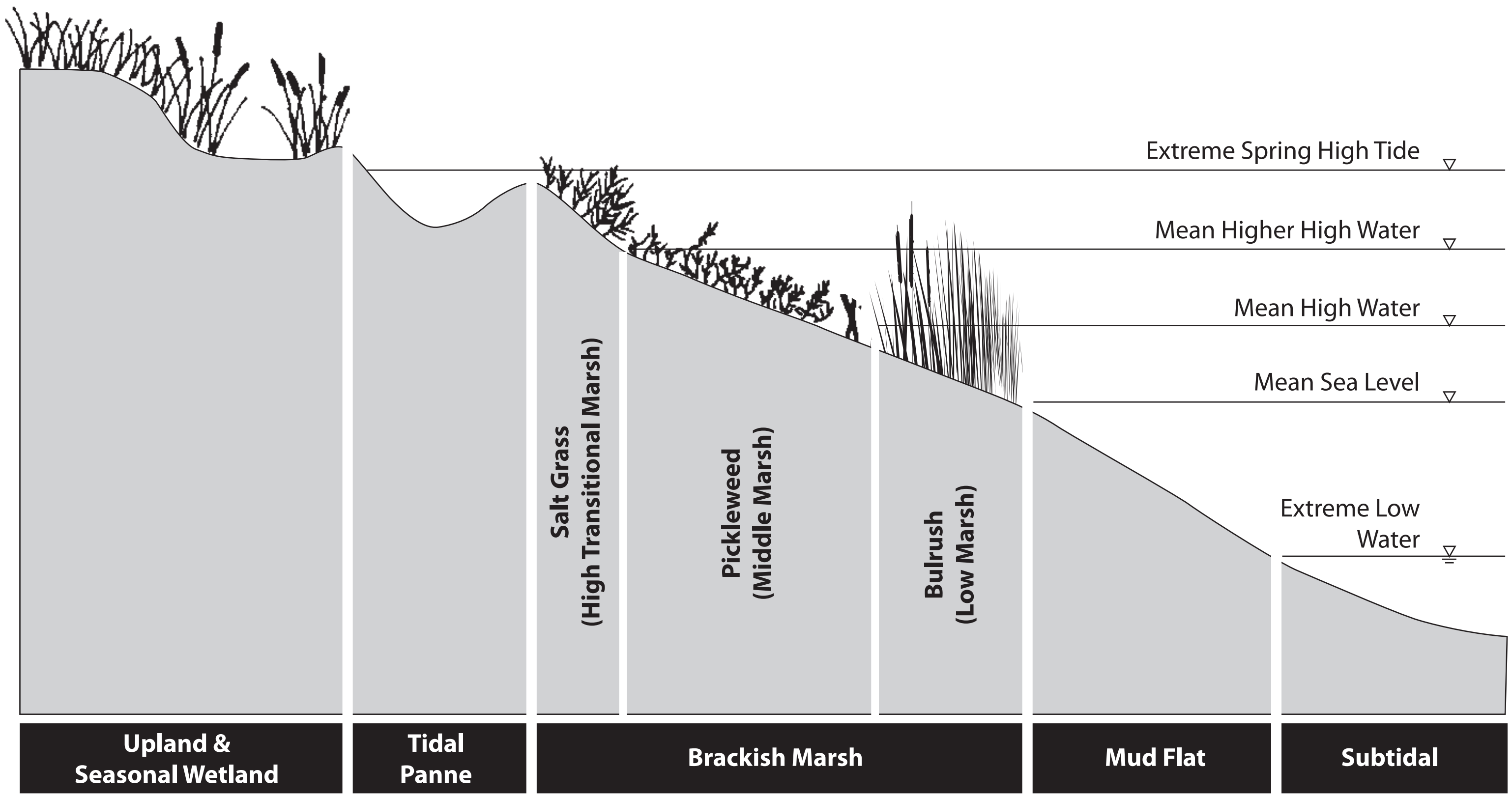
Tidal wetlands in the study area consist of tidal brackish wetlands that occur either as relatively large tracts (complex tidal wetlands) or in narrow bands (fringing tidal wetlands) (Figure 5.1-3). Complex tidal wetlands are larger marsh complexes that have a high area-to-edge ratio and typically have greater geomorphic complexity. Natural and restored complex marshes are found in the SMP area. Complex tidal wetlands typically have large marsh plains, a network of sinuous tidal channels, ponds and pannes on the marsh plain and, when located adjacent to uplands, an upland transition. Fringing tidal marsh exists along the outboard side exterior levees and generally has formed since diking for managed wetlands began. Fringing tidal wetlands vary in size and vegetation composition, are generally far less complex geomorphically, and have a low area-to-edge ratio. Fringing marshes lack connection with the upland transition, are often found in small, discontinuous segments, and can limit movement of terrestrial marsh species (Conceptual Model 2010).

Tidal wetlands consist of several distinct features described in this section: vegetated marsh plains, tidal channels, ponds and pannes within the marsh plain, and aquatic and upland edges. Tidal wetlands are divided into three zones—low marsh, middle marsh, and high marsh. Historically, the high marsh was typically an expansive transitional zone between the tidal wetlands and adjacent uplands. The high marsh and associated upland transition zone have been significantly affected by land use changes (e.g., managed wetlands, agriculture).

The low tidal wetland zone occurs from the mean lower high water (MLHW) elevation to the mean high water (MHW) elevation. This zone is tidally inundated once or twice per day. Plant zonation is influenced by inundation regime and salinity. At the lowest elevations, vegetation is inhibited by frequent, prolonged, often deep inundation and by disturbance by waves or currents. As a result this zone typically has the lowest species richness of the tidal wetland zones (Conceptual Model 2010). The dominant plant species are hardstem bulrush (*Schoenoplectus acutus*) and common bulrush (*S. californicus*). Other common species occurring in the low tidal wetland zone are pickleweed, low-club rush (*Schoenoplectus cernua*), common reed (*Phragmites australis*), common cattail (*Typha latifolia*), and narrow leaf cattail (*Typha angustifolia*) (Suisun Marsh Ecological Workgroup 2001).

The middle tidal wetland zone occurs from MHW to mean higher high water (MHHW). This zone is tidally inundated at least once per day. This zone provides food for wildlife; however, there is relatively little cover and no refuge from higher tides, which completely flood the vegetation of the middle marsh. Plant species composition and richness vary strongly with salinity and thus location in Suisun Marsh. Middle marsh elevations in brackish tidal marshes often exhibit high plant-species richness. The dominant plant species in this zone are pickleweed, saltgrass, and American bulrush (*Schoenoplectus americanus*). Other common species occurring in the middle tidal marsh are fleshy jaumea (*Jaumea carnosa*), sea milkwort (*Glaux maritima*), Baltic rush (*Juncus balticus*), salt marsh dodder (*Cuscuta salina*), alkali heath (*Frankenia salina*), Mexican rush (*Juncus mexicanus*), alkali bulrush (*Bolboschoenus maritimus*), narrow-leafed cattail (*Typha angustifolia*), sneezeweed (*Helenium bigelovii*), and marsh gumplant (*Grindelia stricta* ssp. *angustifolia*) (Suisun Marsh Ecological Workgroup 2001; Conceptual Model 2010).

The high tidal wetland zone occurs between approximately the MHHW elevation to the extreme high water (EHW) elevation (Figure 6.2-2). In fringing tidal wetlands this zone typically is confined to natural levees along tidal creek banks and edges of artificial dikes. In complex tidal wetlands this zone may resemble more natural high tidal wetland elevations. This zone receives intermittent



Source: Woodward-Clyde 1998.

Graphics/Projects/project number/document (date) SS

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Figure 6.2-2
Schematic of Habitats by Tide Levels

inundation during the monthly tidal cycle, with the higher elevations being inundated during only the highest tides. As a result, soil salinity is higher in the high tidal marsh than it is in the other tidal zones because of less frequent leaching of soil salts. High tidal wetlands often accumulate the greatest portion of drift litter (Conceptual Model 2010).

The dominant plant species in this zone are native species, including saltgrass, pickleweed, and Baltic rush (*Juncus balticus*), and nonnative species, including peppergrass (*Lepidium latifolium*), poison hemlock (*Conium maculatum*), and fennel (*Foeniculum vulgare*). Other common species occurring in the high tidal marsh are fat hen (*Atriplex triangularis*), saltmarsh dodder (*Cuscuta salina* var. *major*), fleshy jaumea, seaside arrowgrass (*Triglochin maritima*), alkali heath (*Frankenia salina*), brass buttons (*Cotula coronopifolia*), and rabbitsfoot grass (*Polypogon monospeliensis*). The high tidal marsh also provides habitat for special-status plants, including Suisun Marsh aster (*Symphyotrichum lentum*), Soft bird's beak (*Cordylanthus mollis* ssp. *mollis*), and Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*). (Suisun Marsh Ecological Workgroup 2001; Conceptual Model 2010.)

The upland transition occurs between the high wetland zone and adjacent uplands. This zone provides refuge to wildlife during high tides. It is generally dominated by a variety of plant species, including a mix of high tidal wetland zone species such as pickleweed and Baltic rush as well as more upland species such as yarrow (*Achillea millefolium*), coyote brush (*Baccharis pilularis*), creeping wildrye (*Leymus triticoides* and *L*. x *multiflorus*), California rose (*Rosa californica*), gumplant (*Grindelia stricta*), and alkali heath (*Frankenia salina*) (Conceptual Model 2010).

Managed Wetlands

Managed wetlands in the study area are located in the historical limit of the high tidal marsh and adjacent uplands that were diked and leveled for agricultural purposes and later managed to enhance waterfowl habitat. Diked managed wetlands and uplands are the most common land cover type in the study area, accounting for approximately 52,112 acres, or 66.5%, of the study area. Managed wetlands are most abundant in Region 4, where they compose 28,628 acres (80%) of the land surface. In Regions 1, 2, and 3, managed wetlands account for 67%, 45%, and 45%, respectively, of the land surface (Figure 6.2-1). Managed wetlands are considered seasonal wetlands because they are flooded and drained several times throughout the year.

Managed wetland activities, including the operation of flood and drain gates and the storage and movement of water in the managed wetlands, influence the vegetation communities in the managed wetlands (Suisun Marsh Ecological Workgroup 2001). Additionally the timing, duration, and depth of inundation; salinity of the water used; and soil type and salinity influence the plant communities that occur in a given managed wetland. Typically, the salinity gradient increases from north to south and from east to west (Suisun Marsh Ecological Workgroup 2001).

Water management on privately owned lands in Suisun Marsh varies according to each individual management plan and, as a result, the plant communities vary depending on the management practices. Most management plans stress the importance of a 30-day flood and drain cycle. The objective of water management is to control soil salinities in order to promote a diversity of wetland types within each managed wetland. Plant species diversity is dependent on the depth and duration of soil submergence and wetland topography. The managed wetlands often are graded to provide uniform flooding and draining and managed wetland managers control the timing and duration of flooding to promote growth of waterfowl food plants. Ditches are often dug to increase water circulation throughout the managed wetlands (Conceptual Model 2010). All of the managed wetland activities described in Chapter 2 assist managed wetland managers in meeting their flood and drain goals.

SRCD has developed 11 water management schedules that typify water management strategies used in the Marsh. Site specific regulatory and physical conditions influence actual water management activities for each managed wetland (Conceptual Model 2010). Under existing salinity standards and if late drawdown management is practiced, the wetlands would be dominated by alkali bulrush, cattail, and tule (*Scirpus acutus*) (California Department of Water Resources 2001). Watergrass (*Echinochloa crusgalli*) and smartweed (*Polygonum* spp.) are typically the dominant species in managed wetlands that use fresher water. In managed wetlands that employ late drawdown management bulrush, cattail, and tule are the dominant species. Pickleweed, fat hen, and brass buttons are common in the higher elevations of the managed wetlands. In marshes with higher soil salinity, pickleweed, salt grass, and other salt-tolerant species are dominant. Other plant species that are important for waterfowl production and that occur in the managed wetlands are sea purslane (*Sesuvium verrucosum*), wigeongrass (*Ruppia maritima*), sago pondweed (*Potamageton pectanatus*) and swamp timothy (*Heleochloa schoenoides*). Suisun Marsh aster *(Symphyotrichum lentum)* also is known to occur along interior supply ditches and managed wetlands.

Riparian

Riparian habitat that has been mapped in the study area is limited to small, narrow bands of vegetation along sections of Suisun Creek and several unnamed drainages in the northwest portion of Region 1. The unnamed drainages are associated with creeks that enter Suisun Marsh from the northwestern watersheds and that pass through areas of managed wetlands. Riparian habitat cover varies greatly with the land use and environmental characteristics. Although riparian habitat has been mapped only in Region 1, it is presumed that riparian vegetation also occurs in small isolated areas with suitable water availability, soil textures, and soil salinity gradients throughout the Marsh.

Uplands

Historically, lands adjacent to tidal wetlands were large areas of uplands dominated by grasslands, some of which contained vernal pools. Today much of this habitat is diked, farmed (as in the northern part of the Marsh), or managed for pheasant hunting. Upland habitats that occur in the SMP area include grassland and ruderal areas adjacent to the tidal and managed wetlands. Only small areas of upland habitat remain, and grazing has degraded much of the habitat. Uplands in the Marsh comprise annual grasslands, native perennial grasslands, coyote brush, agricultural areas, and disturbed areas dominated by ruderal herbaceous vegetation associated with the managed wetlands and other developed areas within the Marsh. Upland habitat also may include isolated clusters of woody upland vegetation, both native and nonnative species (e.g., eucalyptus). Uplands provide nesting, foraging, and cover habitat for wildlife in Suisun Marsh. Mallards are the most common breeding waterfowl in the upland nesting areas.

Seasonal Wetlands and Vernal Pools

Historically, seasonal wetlands and vernal pools and associated grassland habitats occurred in upland areas surrounding the Marsh. Seasonal wetlands and vernal pools probably never were widespread in the SMP area. However, low-gradient alluvium surrounds the Marsh, which suggests that vernal pools had a broad historical distribution in the southeastern limits outside the SMP area. A small portion of the study area, directly adjacent to SR 12, falls in the Solano-Colusa Vernal Pool Region (in the northeastern section of the Marsh), as described by USFWS in their *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (December 2005).

Only small areas of seasonal wetland and vernal pool complexes remain, and grazing has degraded much of the habitat. The seasonal wetland and vernal pool complexes remaining in the study area occur in the northern and eastern portions of the study area. These seasonal wetland complexes occur in the Potrero Hills and the south limits of the Montezuma Hills. Seasonal wetland and vernal pools occur outside the limits of the managed wetlands. Grasslands that occur in this land cover type typically are dominated by annual grasslands and forbs, native perennial grasslands, and agricultural areas. These wetland complexes provide nesting, foraging, and cover habitat for wildlife in Suisun Marsh. The seasonal wetland complexes outside of the Marsh and managed wetlands also provide habitat for special-status species, including California tiger salamander and vernal pool invertebrates and plants.

Developed

Developed land mapped in the plan area includes areas with roads, buildings, pipelines, easements, power lines, and other utilities and structures. It also includes barren areas that have been disturbed and are unvegetated. Developed areas also may include areas of ornamental landscaping.

Special-Status Plants

Special-status plant surveys have not been performed specifically for this EIS/EIR; however, a consolidated list of special-status plant species that potentially occur in the study area was generated from several sources:

- USFWS Species List, dated August 25, 2010 (Appendix C; U.S. Fish and Wildlife Service 2010);
- CNDDB (Appendix D; California Natural Diversity Database 2010); Antioch North, Bird's Landing, Denverton, Fairfield South, Honker Bay, and Vine Hill quadrangles;
- California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California (California Native Plant Society 2008); and
- Review of documents and reports prepared for the Suisun Marsh region.

Special-status plant species are species legally protected under the California Endangered Species Act (CESA), the ESA, or other regulations, as well as species considered sufficiently rare by the scientific community to qualify for such listing. Special-status plants and animals are species in the following categories:

- species listed or proposed for listing as threatened or endangered under the ESA (50 CFR 17.12 and various notices in the FR [proposed species]);
- species that are candidates for possible future listing as threatened or endangered under the ESA (69 FR 24876, May 4, 2004);
- species listed or proposed for listing by the State of California as threatened or endangered under CESA (14 CCR 670.5);
- species that meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380);
- plants listed as rare under the California Native Plant Protection Act (California Fish and Game Code, Section 1900 *et seq.*);
- plants considered by CNPS to be "rare, threatened, or endangered in California" (Lists 1B and 2); and
- plants listed by CNPS as plants about which more information is needed to determine their status and plants of limited distribution (Lists 3 and 4), which may be included as special-status species on the basis of local significance or recent biological information.

Table 6.2-3 includes a list of special-status plants that have suitable habitat in the plan area, occur in the plan region, and/or were observed in the study area. The table includes the plant species name, status, habitat, and occurrence in the study area. Appendix D includes a map showing the location of all CNDDB records for special status species in the study area. Each species was evaluated for its potential to occur in the study area; species that are not found in land cover types present in the study area were eliminated from further consideration and are not included in Table 6.2-3. Additionally, species that may occur in the study area but are outside of areas that would be affected by the plan activities are considered in Table 6.2-3 but are not assessed in this document.

The following sections identify the special-status species that occur in tidal or managed wetlands that could be affected by plan actions. These species will be evaluated in the impact section.

Table 6.2-3. Special-Status Plant Species with Potential to Occur in the Study Area

Species Name	Status[a] Fed	State	Other	Distribution	Preferred Habitats	Period Identifiable	Known Occurrences in the Vicinity of the Study Area
Suisun Marsh aster *Symphyotrichum lentum*	–	–	1B, CSC	Sacramento–San Joaquin Delta, Suisun Marsh, Suisun Bay, and Contra Costa, Napa, Sacramento, San Joaquin, and Solano Counties	Tidal brackish and freshwater marsh: 0–10 feet	May–November	Populations recorded in suitable habitat throughout the study area.
Alkali milk-vetch *Astragalus tener* var. *tener*	–	–	1B	Alameda, Contra Costa, Merced, Monterey, Napa, San Benito, Santa Clara, San Francisco, San Joaquin, San Luis Obispo, Solano, Sonoma, Stanislaus, and Yolo Counties	Valley and foothill grassland, vernal pools, playas: 0–200 feet	March–June	Several occurrences in suitable habitat in the northern portion of the study area
Heartscale *Atriplex cordulata*	–	–	1B	Alameda, Butte, Fresno, Glenn, Kern, Madera, Merced, San Joaquin, San Luis Obispo, Solano, Stanislaus, Tulare, and Yolo Counties	Valley and foothill grasslands on sandy, alkaline or saline soils; meadows and seeps: 0–1,200 feet	April–October	Alkali meadows on the east side of Highway 12.
Brittlescale *Atriplex depressa*	–	–	1B	Alameda, Contra Costa, Colusa, Fresno, Glenn, Merced, Solano, Stanislaus, Tulare, and Yolo Counties	Valley and foothill grasslands, vernal pools; playas; meadows and seeps; and chenopod scrub: 0–1,040 feet	May–October	Occurrences on the east side of Montezuma Slough northwest of Molena and in the Potrero Hills.
San Joaquin spearscale *Atriplex joaquiniana*	–	–	1B	Alameda, Contra Costa, Colusa, Fresno, Glenn, Merced, Monterey, Napa, San Benito, Santa Clara, San Joaquin, San Luis Obispo, Solano, Tulare, and Yolo Counties	Valley and foothill grasslands, playas; meadows and seeps; and chenopod scrub: 0–2,700 feet	April–October	Several occurrences in suitable habitat in the northern portion of the study area.
Big tarplant *Blepharizonia plumosa* ssp. *plumosa*	–	–	1B	Interior Coast Range foothills and Alameda, Contra Costa, San Joaquin, Stanislaus*, and Solano* Counties	Annual grassland, on dry hills and plains: 50–1,500 feet	July–October	Species known to occur within the CNDDB search area however there are no occurrences in the study area.

Species Name	Status[a] Fed	State	Other	Distribution	Preferred Habitats	Period Identifiable	Known Occurrences in the Vicinity of the Study Area
Round-leaved filaree *Erodium macrophyllum*	–	–	1B	Alameda, Butte, Contra Costa, Colusa, Fresno, Glenn, Kings, Kern, Lake, Lassen, Los Angeles, Merced, Monterey, Napa, Riverside, Santa Barbara, San Benito, Santa Clara, San Diego, San Joaquin, San Luis Obispo, San Mateo, Solano, Sonoma, Stanislaus, Tehama, Ventura, and Yolo Counties	Valley and foothill grassland: 50–3,900 feet	March–May	One occurrence in vicinity of Antioch, may be extirpated.
Congdon's tarplant *Centromadia [Hemizonia] parryi* ssp. *congdonii*	–	–	1B, CSC	East San Francisco Bay Area, Salinas Valley, and Los Osos Valley	Annual grassland on lower slopes, flats, and swales, sometimes on alkaline or saline soils: 3–700 feet	June–November	Species known to occur within the CNDDB search area however there are no occurrences in the study area.
Pappose tarplant *Centromadia [Hemizonia] parryi* ssp. *parryi*	–	–	1B,	Butte, Colusa, Glenn, Lake, Napa, San Mateo, Solano, and Sonoma Counties	Valley and foothill grassland, meadows and seeps, marshes and swamps, coastal prairie: 0–1,365 feet	May–November	Species known to occur within the CNDDB search area however there are no occurrences in the study area.
Suisun thistle *Cirsium hydrophilium* var. *hydrophilium*	E	–	1B	Solano County	Salt marshes	July–September	Four occurrences in the study area
Suisun thistle Critical habitat							
Hispid bird's-beak *Cordylanthus mollis* ssp. *hispidus*	–	–	1B	Alameda, Fresno, Kern, Merced, Placer, and Solano Counties	Valley and foothill grassland, meadows and seeps, playas: 0–500 feet	June–September	One occurrence northeast of the study area.
Soft bird's-beak *Cordylanthus mollis* ssp. *mollis*	E	R	1B	Contra Costa, Marin, Napa, Sacramento, Solano, and Sonoma Counties	Salt marshes	July–November	Eleven occurrences in the study area.
Soft bird's-beak Critical habitat							

Species Name	Status[a] Fed	State	Other	Distribution	Preferred Habitats	Period Identifiable	Known Occurrences in the Vicinity of the Study Area
Hoover's Cryptantha *Cryptantha hooveri*	–	–	1B	Contra Costa, Kern, Madera, and Stanislaus Counties.	Valley and foothill grassland, inland dunes: 10–500 feet	April–May	One occurrence in vicinity of Antioch, may be extirpated.
Dwarf Downingia *Downingia pusilla*	–	–	2	Fresno, Merced, Napa, Placer, Sacramento, San Joaquin, Solano, Sonoma, Stanislaus, Tehama, and Yuba Counties	Valley and foothill grassland, vernal pools: 0–1,450 feet	March–May	Two occurrences in Region 3 and one occurrence in Region 4.
Contra Costa wallflower *Erysimum capitatum* ssp. *angustatum*	E	E	1B	Contra Costa County	Inland dunes: 6–70 feet	March–July	Known only from the Antioch Dunes. No occurrences in the study area.
Contra Costa wallflower Critical habitat							
Diamond-petaled California poppy *Eschscholzia rhombipetala*	–	–	1B	Alameda, Contra Costa, Colusa, San Joaquin, San Luis Obispo, and Stanislaus Counties	Valley and foothill grassland: 0–3,200 feet	March–April	One occurrence in vicinity of Antioch, may be extirpated.
Fragrant fritillary *Fritillaria liliacea*	–	–	1B	Alameda, Contra Costa, Monterey, Marin, San Benito, Santa Clara, San Francisco, San Mateo, Solano, and Sonoma Counties	Valley and foothill grassland, coastal prairie, and scrub, cismontane woodland: 6–1,300 feet	February–April	One occurrence in the Montezuma Wetlands Project site in Region 3.
Marsh gumplant *Grindelia stricta* ssp. *angustifolia*	–	–	4	Alameda, Contra Costa, Marin, Napa, Riverside, Santa Clara, San Francisco, San Mateo, Solano, Sonoma	Salt marshes, estuarine wetlands: 0–33 feet		No occurrences in the study area. Suitable habitat in the study area.
Rose-mallow *Hibiscus lasiocarpus*	–	–	2	Central and southern Sacramento Valley, deltaic Central Valley, and Butte, Contra Costa, Colusa, Glenn, Sacramento, San Joaquin, Solano, Sutter, and Yolo Counties	Wet banks and freshwater marshes: generally sea level to 135 feet	August–September	No known occurrences in the study area.
Carquinez goldenbush *Isocoma arguta*	–	–	1B, CSC	Deltaic Sacramento Valley, Suisun Slough, and Contra Costa and Solano Counties	Annual grassland on alkaline soils and flats: generally 3–60 feet	August–December	Several occurrences on the east side of Regions 3 and 4.

Species Name	Status[a] Fed	State	Other	Distribution	Preferred Habitats	Period Identifiable	Known Occurrences in the Vicinity of the Study Area
Northern California black walnut (native stands) *Juglans californica* var. *hindsii*	–	–	1B, CSC	Native stands in Contra Costa, Napa, Sacramento*, Solano*, and Yolo* Counties	Riparian scrub and woodland: 150–2,700 feet	April–May	Scattered trees occur throughout south Delta but not as entire stands. No CNDDB records within 5 miles of project area. One tree is present near Grant Line site.
Contra Costa goldfields *Lasthenia conjugens*	E	–	1B	Alameda, Contra Costa, Mendocino, Monterey, Marin, Napa, Santa Barbara, Santa Clara, Solano, and Sonoma Counties	Valley and foothill grassland, vernal pools, playas, and cismontane woodland: 0–1,500 feet	March–June	Several occurrences in the Suisun Marsh Secondary Management Area.
Contra Costa goldfield Critical habitat							
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	–	–	1B, CSC	Central Valley (especially the San Francisco Bay region) and Alameda, Contra Costa, Fresno, Marin, Napa, Sacramento, San Benito, Santa Clara, San Joaquin, and Solano Counties	Coastal and estuarine marshes: sea level–15 feet	May–June	Numerous occurrences throughout the study area.
Legenere *Legenere limosa*	–	–	1B	Alameda, Lake, Napa, Placer, Sacramento, Santa Clara, Shasta, San Joaquin, San Mateo, Solano, Sonoma, Stanislaus, Tehama, and Yuba Counties	Vernal pools: 0–2,860 feet	April - June	Two occurrences in suitable habitat outside the study area.
Mason's lilaeopsis *Lilaeopsis masonii*	–	R	1B, CSC	Southern Sacramento Valley, Sacramento–San Joaquin Delta, northeast San Francisco Bay area, and Alameda, Contra Costa, Marin*, Napa, Sacramento, San Joaquin, and Solano Counties	Freshwater and intertidal marshes and streambanks in riparian scrub: generally sea level–30 feet	April–October	Several occurrences throughout the study area.
Delta mudwort *Limosella subulata*	–	–	2	Contra Costa, Sacramento, San Joaquin, and Solano Counties; Oregon; Atlantic coast	Intertidal marshes: sea level–10 feet	May–August	Suitable habitat in the study area. One occurrence along Montezuma Slough.

Species Name	Status[a] Fed	State	Other	Distribution	Preferred Habitats	Period Identifiable	Known Occurrences in the Vicinity of the Study Area
Showy madia *Madia radiata*	–	–	1B	Contra Costa, Fresno, Kings, Kern, Monterey, Santa Barbara, San Benito, San Joaquin, San Luis Obispo, and Stanislaus Counties	Valley and foothill grassland, cismontane woodland: 80–2,900 feet	March–May	No occurrences in the study area.
Antioch Dunes evening-primrose *Oenothera deltoides* ssp. *howellii*	E	E	1B	Contra Costa and Sacramento Counties	Inland dunes: 0–100 feet	March–September	No occurrences in the study area.
Antioch Dunes evening-primrose Critical habitat							
Bearded popcorn-flower *Plagiobothrys hystriculus*	–	–	1B	Solano County	Valley and foothill grassland, vernal pools: 0–170 feet	April–May	Suitable habitat occurs on study area. Two occurrences in eastern portion of the study area.

Notes:

CNDDB = California Natural Diversity Database.

[a] Status

Federal

E = Endangered

– = No federal status.

State

CE = Listed as endangered under the California Endangered Species Act.

R = Listed as rare under California Native Plant Protection Act.

California Native Plant Society (CNPS)

1B = CNPS List 1B—rare or endangered in California and elsewhere

2 = CNPS List 2—rare or endangered in California, more common elsewhere

4 = CNPS List 4 – plants of limited distribution

CALFED

CSC = Other species of concern identified by CALFED.

– = No state status.

Soft Bird's-Beak

Soft bird's-beak (*Cordylanthus mollis* var. *mollis*) is an annual herb that occurs in the high marsh and upland transitional zones and in seasonally flooded alkaline wetlands (California Department of Water Resources 2001). Soft bird's-beak is federally listed as endangered, is state-listed as rare, and is listed by CNPS as a Category 1B species. There are 11 occurrences in the study area (California Natural Diversity Database 2010 [Appendix D]). Soft bird's-beak is thought to be limited to three general locations in Suisun Marsh: Rush Ranch, DFG's Joice Island Unit of the Grizzly Island Wildlife Management Area, and the Hills Slough marsh (California Department of Water Resources 2001); however, this species also occurs on Luco Slough and east of Bradmoor Island (California Natural Diversity Database 2010). The Hill Slough population accounts for more than 80% of the occurrences of this species in the study area (California Department of Water Resources 1999).

Two critical habitat units identified for soft bird's-beak occur in the study area. These units are Unit 2, Hill Slough Wildlife Management Area, and Unit 4, Rush Ranch/Grizzly Island Wildlife Management Area (72 FR 18528, April 12, 2007).

Suisun Thistle

Suisun thistle (*Cirsium hydrophilium* var. *hydrophilium*) is a perennial herb that occurs in tidal saltmarsh habitat along sloughs and rivers. This species is known to exist only in Suisun Marsh. This species typically is found in the study area in the middle to high marsh zone along tidal channels and in irregularly flooded estuarine wetlands (California Department of Water Resources 2001). Suisun thistle is federally listed as endangered and is listed by CNPS as a Category 1B species. Three populations of Suisun thistle are known (California Department of Water Resources 2001), and there are four occurrences in the study area (California Natural Diversity Database 2010 [Appendix D]). One population occurs on DFG's Peytonia Slough Ecological Reserve in Region 1. The second population and the remaining occurrences are associated with the Cutoff Slough tidal marshes and DFG's Joice Island Unit of the Grizzly Island Wildlife Management Area.

Three critical habitat units have been identified for Suisun thistle in the study area. These units are Unit 1, Hill Slough Marsh; Unit 2, Peytonia Slough Marsh; and Unit 3, Rush Ranch/Grizzly Island Wildlife Area (72 FR 18527, April 12, 2007).

Suisun Marsh Aster

Suisun Marsh aster (*Symphyotrichum lentum*) is a perennial herb that occurs in tidal brackish marsh habitat along sloughs and rivers. This species is typically found in the study area in the middle marsh zone and in regularly flooded estuarine wetlands and intertidal banks (California Department of Water Resources 2001). Suisun Marsh aster also is known to occur along interior supply ditches and managed wetlands. Suisun Marsh aster is a federal species of concern and is listed by CNPS as a Category 1B species. There are 36 occurrences of Suisun Marsh aster in the study area (California Natural Diversity Database 2010 [Appendix D]).

Delta Tule Pea

Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*) is a perennial herb that occurs in the middle to high marsh zones, tidally influenced banks channels, and in regularly flooded estuarine wetlands (California Department of Water Resources 2001). Delta tule pea is a federal species of concern and is listed by CNPS as a Category 1B species. There are 61occurrences of delta tule pea in the study area (California Natural Diversity Database 2010 [Appendix D]).

Mason's Lilaeopsis

Mason's lilaeopsis (*Lilaeopsis masonii*) is a diminutive rhizomatous perennial herb that typically occurs in the intertidal zone on clay or silt tidal mudflats with high organic matter content (Golden and Fiedler 1991). Mason's lilaeopsis is state-listed as rare and listed by CNPS as a Category 1B species. Field surveys performed by DWR and DFG between 1990 and 1993 located Mason's lilaeopsis throughout most regions of the Marsh (California Department of Water Resources 1999). Based on CNDDB records there are 27 occurrences of Mason's lilaeopsis in the study area (California Natural Diversity Database 2010 [Appendix D]).

Delta Mudwort

Delta mudwort (*Limosella subulata*) is a low-growing, herbaceous perennial that occurs on muddy or sandy intertidal flats, sometimes in association with Mason's lilaeopsis (Golden and Fiedler 1991).

Delta mudwort has no federal or state designation but is listed by CNPS as a Category 2 species. Field surveys performed by DWR and DFG between 1990 and 1993 located Mason's lilaeopsis throughout most regions of the Marsh (California Department of Water Resources 1999), and there is one CNDDB record of delta mudwort in the study area (California Natural Diversity Database 2010 [Appendix D]).

Regulatory Setting

This section provides preliminary information on the major requirements for permitting and environmental review and consultation related to vegetation and waters of the United States for implementation of the SMP. Certain local, state, and federal regulations require issuance of permits before plan implementation; other regulations require agency consultation but may not require issuance of any entitlements before plan implementation. The exact requirements will be determined at a project-specific level as projects are proposed. The sections below outline the general regulatory requirements for projects of this nature. It is possible that over the 30-year implementation period, regulations may be modified, eliminated, or created and that species may be listed or delisted. As such, project-specific analysis will include relevant updates and changes in impact assessment as necessary.

Federal

The following federal requirements are discussed in detail in Chapter 10: ESA, Fish and Wildlife Coordination Act, CWA Section 404(b)(1) Guidelines and Section 401, River and Harbors Appropriation Act of 1899 and Executive Order 11990 (Protection of Wetlands).

State

The following state requirements are discussed in detail in Chapter 10: CESA, Section 1602 of the California Fish and Game Code and San Francisco Bay Conservation and Development Commission. Additional State requirements pertinent to vegetation and wetlands are discussed below.

California State Wetlands Conservation Policy

The Governor of California issued an executive order on August 23, 1993, that created a California State Wetlands Conservation Policy. This policy is being implemented by an interagency task force that is jointly headed by the State Resources Agency and the California Environmental Protection Agency (Cal-EPA). The policy's three goals are to (Cylinder et al. 1995):

1. ensure no overall net loss and a long-term net gain in wetlands acreage and values in a manner that fosters creativity, stewardship, and respect for private property;
2. reduce the procedural complexity of state and federal wetland conservation program administration; and
3. encourage partnerships that make restoration, landowner incentives, and cooperative planning the primary focus of wetlands conservation.

California Water Resources Control Board

Water Code Section 13260 requires “any person discharging waste, or proposing to discharge waste, in any region that could affect the waters of the state to file a report of discharge (an application for waste discharge requirements).” Under the Porter-Cologne definition, the term *waters of the state* is defined as “any surface water or groundwater, including saline waters, within the boundaries of the state.” Although all waters of the United States that are within the borders of California are also waters of the state, the converse is not true (i.e., in California, waters of the United States represent a subset of waters of the state). Thus, California retains authority to regulate discharges of waste into any waters of the state, regardless of whether the Corps has concurrent jurisdiction under Section 404.

Local

The following local and regional regulations are discussed in detail in Chapter 10: Suisun Marsh Protection Act of 1974 and Suisun Marsh Protection Act of 1977. The applicable Solano General Plan elements are discussed below.

Solano County General Plan

The Solano County General Plan (SCGP) identifies several issues and opportunities related to biological resources (EDAW/AECOM 2006):

1. An issue identified in the SCGP is declining critical habitat. Natural habitats in Solano County have been altered and degraded by urban development and agricultural practices, among other actions. In the study area, critical habitat has been designated for Suisun thistle and soft bird’s-beak.
2. Biological resource conservation practices throughout Solano County also may provide for the preservation of agricultural lands.

Environmental Consequences

Assessment Methods

Vegetation and wetland resources could be directly or indirectly affected by the SMP. Tidal wetland restoration will result in the loss/conversion of managed wetland or other land cover types. Additionally, the following types of SMP activities could cause varying degrees of temporary or permanent impacts on these resources (e.g., loss or degradation of habitat):

- levee breaching or grading (e.g., direct loss of habitat);

- increased scour due to levee breaching (e.g., degradation of tidal wetlands and tidal perennial aquatic habitat);
- grading and other ground-disturbing activities (e.g., loss or degradation of land cover types or special-status plant populations);
- installation of temporary water-diversion structures (e.g., loss or degradation of land cover types or special-status plant populations);
- temporary stockpiling and sidecasting of soil, construction materials, or other construction debris(e.g., loss or degradation of land cover types or special-status plant populations);
- introduction of invasive nonnative species in construction areas could displace native plant species in adjacent open space areas (e.g.; spread of peppergrass [*Lepidium latifolium*] in construction areas through movement of soil);
- dredging activities in wetlands and channels that contain ponded or flowing water and saturated soils (e.g., degradation of tidal wetlands and tidal perennial aquatic habitat);
- placement of dredged material on the crown and backslope of levees (e.g., loss or degradation of land cover types or special-status plant populations).

Impact Analysis Assumptions

The SMP would result in temporary and permanent impacts on vegetation and wetland resources in the plan area. Temporary impacts would be those that occur only during the construction period associated with restoration and enhancement of wetlands. Permanent impacts would occur as a result of irreversible changes in land cover types.

Impact Assessment Approach and Methods

This vegetation and wetland resources impact analysis is based on:

- the most current proposed implementation of the SMP, as summarized in the above assumptions and described in Chapter 2, and
- existing biological resource information (sources are discussed under Affected Environment).

The mitigation measures for impacts on vegetation and wetland resources were developed through review of the plan description, prior environmental impact studies and reports for affected resources, discussions with resource agency personnel, and professional judgment.

Significance Criteria

The criteria for determining significant impacts on biological resources were developed by reviewing the State CEQA Guidelines. Based on these sources of information, the SMP likely would cause a significant impact if it would result in:

- Net loss of wetland acres and functions and values including waters of the United States;
- substantial loss of woody riparian vegetation;
- substantial loss of occupied special-status species habitat;
- a reduction in the area and functions within Suisun Marsh of rare natural communities;
- cause a plant population to drop below self-sustaining levels;
- the spread or introduction of new noxious weed species into the plan area; and
- reduce the number or restrict the range of an endangered, rare, or threatened plant species or plant species of special concern..

Environmental Impacts

No Action Alternative

Under the No Action Alternative, the SMP would not be implemented. As a result, the amount of restoration in the Marsh likely would be limited, as described in Chapter 2. Additionally, any levee breaches that occur in inaccessible areas would not be fixed, and passive restoration would occur in those areas.

Under the No Action Alternative, most habitat types and values for sensitive species would not change. Diversion restrictions on managed wetlands would continue to be enforced, and programs to encourage landowners to manage properties to protect certain habitat values would continue to be implemented. Additionally, programs to control managed wetland vegetation would continue. Installation of new water diversions would continue to be prohibited and fish screens would continue to be installed on existing diversions where feasible. Existing programs to control nonnative species and protect sensitive wetlands from the adverse effects of grazing would continue to be implemented.

No additional significant effects of the No Action Alternative are anticipated. No mitigation is required.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Restoration Impacts

Impact VEG-1: Short-Term Loss or Degradation of Tidal Wetlands and Tidal Perennial Aquatic Communities in Slough Channels Downstream of Restoration Sites as a Result of Increased Scour

Tidal wetland restoration would occur by breaching and/or lowering exterior levees to restore tidal inundation to restoration sites. Breach locations would be chosen to minimize upstream tidal muting, tidal elevation changes, channel scour, and hydraulic changes. Temporary increased scour could occur as a result of greater flows near breach sites (See Section 5.6, Sediment Transport).

As such, existing tidal wetlands in the vicinity of the affected levee sections may be impacted as a result of increased scour. This could result in a temporary conversion of a small amount of tidal wetlands to tidal perennial aquatic habitat (e.g., bay or slough habitat), depending on the site-specific conditions. As the area stabilizes, some or all of the tidal wetlands may reestablish.

Existing tidal perennial aquatic habitat in the vicinity of the affected levee sections may be degraded because of increased scour. Tidal perennial aquatic habitat would be restored within the restoration sites in the Marsh. The quantity of tidal perennial aquatic habitat restored at a specific location would vary depending on the existing or graded land surface elevations and tidal water surface elevations within each restoration site.

Tidal wetland restoration sites, including the created habitat levees, intertidal zones, and tidal wetland habitat that form over time from sediment accumulation and the tidal perennial aquatic habitat that would be restored, would more than offset any temporary loss or degradation of tidal wetland habitat or tidal perennial aquatic habitat.

Conclusion: Less than significant. No mitigation required.

Impact VEG-2: Loss or Degradation of Tidal Wetlands Adjacent to Restoration Sites as a Result of Levee Breaching/Grading

Tidal wetland restoration would occur by breaching and/or lowering exterior levees to restore tidal inundation to restoration sites. Existing tidal wetlands in the vicinity of the affected levee sections may be lost because of construction-related activities. Although a relatively small amount of tidal wetlands may be lost or degraded during levee breaching, the restoration of tidal action would restore a much greater acreage of tidal wetland habitat that would be impacted.

Conclusion: Less than significant. No mitigation required.

Impact VEG-3: Loss of Managed Wetlands as a Result of Tidal Wetland Restoration

Tidal wetland restoration would occur by breaching and/or lowering exterior levees that currently protect managed wetlands and/or upland habitats from tidal inundation, resulting in the restoration and conversion of managed wetlands to tidal wetlands and perennial aquatic habitat. The restoration sites are expected to evolve into tidal wetlands providing a range of elevations to support different wetland types. There would be an overall decrease in the quantity of managed wetlands in Suisun Marsh. The effects of this land cover type conversion on wetlands and special-status plant species are assessed below and the effects on wildlife and fish are assessed in Sections 6.3 and 6.1, respectively.

The loss of managed wetlands may range from 5,000 to 7,000 acres under the Proposed Project. The construction of habitat levees or other levees may result in fill of managed wetlands, but this would not result in a loss of jurisdictional wetlands acres because the managed wetlands would be converted to tidal wetlands and associated open water habitat, and includes the removal of some exterior levees.

The restoration design includes construction of habitat levees, benches and other features which would be constructed prior to levee breaching and would provide some of the functions and values as the managed wetlands. As the tidal wetlands become established, they would increase a variety of wetland functions and values. The tidal wetlands would provide habitat and food sources that benefit tidal wetland-dependent species and many, but not all, managed-wetland dependent species.

Conclusion: Less than significant. No mitigation required.

Impact VEG-4: Loss of Upland Plant Communities and Associated Seasonal Wetland Habitat as a Result of Tidal Wetland Restoration

Tidal wetland restoration would occur by breaching and/or lowering exterior levees to allow tidal inundation of the lands within the levees. Upland plant communities, including annual grasslands and ruderal vegetation, may occur on the interior levee surfaces or on natural or altered land surfaces that were previously protected by the levees. Natural seasonal wetlands (e.g., vernal pools) may occur in some of the upland communities within or immediately adjacent to Suisun Marsh. Upland areas and associated natural seasonal wetland habitat would be protected as described in Chapter 2. This includes selection of breach sizes and locations in consideration of habitats that would be affected. Therefore, the primary impact on upland plant communities is expected to occur on the levee surfaces that are altered to create habitat levees or that become subject to tidal inundation. No impact to associated seasonal wetland habitat would occur.

Existing levee surfaces could support upland/high marsh transition plant species, including special-status plant species. The proposed restoration may result in minor inundation of some areas if the natural tidal stage is higher than the managed wetland water level. Although immediately upon inundation there could be changes in habitat types on the levee surfaces, the tidally restored area would increase the high marsh habitat available to these species through the construction of habitat levees and islands. It is expected that the plants would shift to occupy the new and expanded high marsh habitat.

Conclusion: Less than significant. No mitigation required.

Impact VEG-5: Spread of Noxious Weeds as a Result of Restoration Construction

Construction activities related to tidal restoration actions could result in the introduction or spread of noxious weed species, which could displace native species, thereby changing the diversity of species or number of any species of plants. Soil-disturbing activities during construction could promote the introduction of plant species that currently are not found in the project area, including exotic pest plant species. Construction activities also could spread exotic pest plants that already occur in the project area.

As described in the Environmental Commitments section of Chapter 2, several measures would be implemented to avoid the spread of nonnative plants. Additionally, proposed restoration sites would be managed to promote tidal wetland vegetation so when inundation occurs, there is minimal potential to support nonnative species.

Conclusion: Less than significant. No mitigation required.

Impact VEG-6: Loss of Special-Status Plants or Suitable Habitat as Result of Tidal Wetland Restoration

Special-status plants and suitable habitats are known to occur in the study area. Species and suitable habitat potentially impacted include soft bird's-beak, Suisun thistle, Mason's lilaeopsis , Delta tule pea, Delta mudwort, and Suisun Marsh aster. For soft bird's-beak, four critical habitat units have been identified and three critical habitat units have been identified for Suisun thistle. Construction activities associated with tidal wetland restoration could affect populations of soft bird's beak. As described in the Environmental Commitments section of Chapter 2, if initial screening by a qualified biologist identifies the potential for special-status plant species to be directly or indirectly affected by a site-specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species' habitat. However, indirect effects related to restoration, such as scour adjacent to the breach location, could result in a loss of suitable habitat for bird's-beak. As described in Chapter 2, breach size and location would be selected to minimize effects of scour on special-status species. Any potential impacts to suitable special-status plant species habitat from temporary tidal restoration actions would be more than offset by the range of marsh elevations and associated habitats that would be created and restored by the tidal restoration actions, resulting in more suitable habitat for all special-status plant species and contributing to the recovery of these species.

Conclusion: Less than significant. No mitigation required.

Impact VEG-7: Degradation of Native Plant Species and Spread of Invasive Plant Species as a Result of Increased Public Access

Public access is restricted throughout most of Suisun Marsh because much of the Marsh is private land. Tidal wetland restoration projects may occur on private or public lands and may result in an increase in public access. Increased public access could result in increased pedestrian traffic in the vicinity of sensitive habitat or special-status plant populations. As described for Recreational Environmental Commitments in Chapter 2, access would be restricted through signage, buffers, and seasonal restrictions to minimize adverse effects on sensitive wildlife and vegetation.

Conclusion: Less than significant. No mitigation required.

Impact VEG-8: Loss or Degradation of Tidal Native Plant Species as a Result of Tidal Muting

Tidal wetland restoration would occur by breaching and/or lowering exterior levees to restore tidal inundation to restoration sites. Breach locations would be chosen to minimize temporary upstream tidal muting and the implementation of restoration over a 30-year period and spread throughout the Marsh, as well as sea level rise would minimize the potential for substantial tidal muting. Although tidal muting could result in a temporary reduction in the tidal water surface elevation range, the overall acreage of tidal wetlands in the Marsh would substantially increase as a result of restoration actions.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities Impacts

Impact VEG-9: Loss of Special-Status Plants or Suitable Habitat as Result of Exterior Levee Activities

The increased frequency of currently implemented managed wetland activities and the new activities intended to maintain or improve exterior levees would have the potential to affect special-status plants, including soft bird’s-beak, Suisun thistle, Suisun Marsh aster, Delta tule pea, Mason’s lilaeopsis, and Delta mudwort. These species occur throughout the Marsh in mid- to high-marsh areas. The most common practices for repairing exterior levees in Suisun Marsh involve the removal of accumulated silt and vegetation from water circulation ditches or pond bottom grading in managed wetlands and placement of spoil material on the crown of adjacent levees to raise the crown to its original or design height and/or improve interior side slopes. Material also is proposed to come from dredging of adjacent tidal sloughs. (The impact of dredging is discussed specifically below.)

It is unlikely that a significant amount of levee repair material would be lost to the outboard side of an exterior levee below the mean high water line. A limited amount of material on the outside slope of the levee from the crown probably would not significantly impact special-status plants or their suitable habitat. Exterior levee activities would not result in changes in tidal stage, flows, or erosion that would significantly impact special-status plants or their suitable habitat. As described in the Environmental Commitments section of Chapter 2, if initial screening by a qualified biologist identifies the potential for special-status plant species to be directly or indirectly affected by a site-specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species' habitat.

Conclusion: Less than significant. No mitigation required.

Impact VEG-10: Loss or Degradation of Wetland Communities and Special-Status Plant Species in Slough Channels as a Result of Channel Dredging

Excavator bucket or clamshell dredging could occur either from a barge in the river channel or from the top of a levee, depending on restrictions caused by vegetation on channel banks or the width and depth of a channel. Dredging would occur in the center of slough channels, adjacent to fish screens, and in historical dredger cuts. As much as possible, vegetation would be avoided by not dredging adjacent to tidal berms more than 50 feet wide, dredging from the center channel to avoid emergent vegetation often found along levee slopes, and avoiding other areas with prominent vegetation.

Excavator bucket or clamshell dredging would avoid direct impacts on tidal emergent wetlands and managed wetlands. Indirect impacts of dredging could include temporary decreased water quality caused by turbidity. Tidal wetland vegetation would not be significantly affected by the temporary, small increase in channel water turbidity.

Equipment operation and dredged material placement could affect tidal and managed wetland habitat and associated special-status plant species populations. As described in the Environmental Commitments section of Chapter 2, if initial screening by a qualified biologist identifies the potential for special-status plant species to be directly or indirectly affected by a site-specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species' habitat.

Conclusion: Less than significant. No mitigation required.

Impact VEG-11: Loss or Degradation of Rare Natural Communities and Special-Status Plant Species as a Result of New Fish Screen Facilities

New fish screens could be constructed on existing diversion facilities or at new diversion locations. Construction activities associated with construction of new fish screen facilities could temporarily affect tidal wetlands, managed wetland habitat, and associated special-status plant species populations. As described in Chapter 2 under Environmental Commitments, several measures would be in place to identify and avoid special-status plants and sensitive habitat communities, and fish screen structures would only affect small areas throughout the Marsh. Temporarily disturbed areas would reestablish following completion of fish screen activities. Additionally, restoration activities would result in an increase of quality and quantity of habitat for many rare natural communities in the Marsh and associated special-status plant species.

Conclusion: Less than significant. No mitigation required.

Impact VEG-12: Loss or Disturbance of Managed Wetlands as a Result of Increased Frequency of Activities within Managed Wetlands

Several activities would occur in managed wetlands with increased frequency (e.g., new interior levee construction, grading, duck blinds, v-ditches), which could disturb managed wetlands. Activities would occur throughout the Marsh over the 30-year period of the Proposed Project and would typically be implemented in dry conditions during August and September.

Construction activities could result in temporary and permanent impacts on managed wetland habitat, however there will be no net loss of wetland acres and functions and values, since any impacts on managed wetlands will be offset on-site or through tidal wetland restoration.

Conclusion: Less than significant. No mitigation required.

Impact VEG-13: Loss or Disturbance of Tidal Wetlands or Other Waters of the United States and Special-Status Plant Species as a Result of Placement of New Riprap and Alternative Bank Protection Methods

The placement of new riprap and alternative bank protection (i.e., brush boxes, biotechnical wave dissipaters) on exterior and interior levee surfaces in areas that were not previously riprapped could result in temporary and permanent effects on tidal wetland, bays and sloughs or special-status plant species. Pre-construction surveys for special-status plant species will be performed in locations proposed for riprap and alternative bank protection placement. If special-status plants are identified, their populations will be avoided. Riprap and alternative bank protection would be needed primarily in areas that currently do not have vegetation, and as described in Chapter 2 under Environmental Commitments, special-status plant species would be identified and avoided so there would be no impacts on special-status plant species or their habitat, including critical habitat.

Although riprap and alternative bank protection placement could result in permanent fill of other waters of the United States, there will be no net loss of wetland acres and functions and values, since any impacts will be offset by managed wetland on-site enhancement and through tidal wetland restoration, resulting in high functions and values for restored tidal wetlands and other waters of the United States.

Conclusion: Less than Significant. No mitigation required.

Impact VEG-14: Loss or Disturbance of Wetlands and Special-Status Plant Species as a Result of DWR/Reclamation Facility Maintenance Activities

DWR/Reclamation facility maintenance activities, as described in Chapter 2 under Managed Wetland Activities, could result in temporary and permanent effects on tidal wetland, bays and sloughs, managed wetlands, and special-status plant species populations. These maintenance activities would be implemented to improve water conditions within the Marsh and result in higher quality wetland habitat by improving water quality and providing more reliable water conveyance systems. Areas of temporary disturbance would be restored following completion of the maintenance activity. Restoration activities included in the SMP would increase the total acreage of tidal wetlands, including suitable habitat for special-status plant species. The Environmental Commitments as described in Chapter 2 would be implemented to protect wetlands and special-status plants.

Conclusion: Less than significant. No mitigation required.

Impact VEG-15: Introduction or Spread of Noxious Weeds as Result of Managed Wetland Activities

Some managed wetland activities that disturb the soil have the potential to create barren areas in which noxious weeds may establish. Additionally, all construction equipment, if not properly cleaned, could import noxious species to construction areas. Managed wetland activities are intended to improve water management to promote certain vegetation communities. Disturbed areas will be seeded and/or plant with native species to promote the desired vegetation and control the spread of noxious weeds, thus limiting the potential for colonization of noxious weeds.

Conclusion: Less than significant. No mitigation required.

Alternative B: Restore 2,000–4,000 Acres

Impacts for Alternative B are similar to impacts for Alternative A for site-specific impact mechanisms. The overall Marsh landscape would change slightly compared to existing conditions and less than Alternative A. Because there would be less restoration, the frequency of restoration impacts would be less, and the frequency of managed wetland activities and their impacts would be more.

Alternative C: Restore 7,000–9,000 Acres

Impacts for Alternative C are similar to impacts for Alternative A for site-specific impact mechanisms. The overall Marsh landscape would change more compared to existing conditions and more than Alternative A. Because there would be more restoration, the frequency of restoration impacts would be greater, and the frequency of managed wetland activities and their impacts would be less.

Section 6.3 Wildlife

Introduction

This section describes the existing environmental conditions and the consequences of implementing the SMP alternatives on wildlife resources.

The Affected Environment discussion below describes the current setting of the plan area. The purpose of this information is to establish the existing environmental context so the reader can understand the environmental changes caused by the implementation of the SMP alternatives. The environmental changes associated with the plan are discussed under Impact Analysis. This section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary.

Summary of Impacts

The tidal wetland restoration actions, specifically levee breaching, initially would result in the establishment of tidal open water habitat. Tidal wetland vegetation would establish as sediment accrues over time (Figure 2-1). There initially would be some impacts on managed wetland habitats. These values would be replaced as part of the restoration design and increased as tidal wetland vegetation becomes established. Additionally, the implementation of the managed wetland activities would ensure that the remaining managed wetlands continue to provide suitable habitat.

Table 6.3-1 presents a summary of the impacts on wildlife and applicable mitigation measures that are associated with each plan alternative. The impact sections provide a detailed discussion of all impacts and mitigation measures.

Table 6.3-1. Summary of Wildlife Impacts and Mitigation Measures

Impact	Alternative	Significance before Mitigation	Mitigation Measure	Significance after Mitigation
Restoration Impacts				
WILD-1: Loss or Disturbance of Salt Marsh Harvest Mouse Suitable Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measure	Significance after Mitigation
WILD-2: Loss or Disturbance of California Clapper Rail Suitable Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
WILD-3: Loss or Disturbance of California Black Rail Suitable Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
WILD-4: Loss or Disturbance of Suisun Shrew Suitable Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
WILD-5: Loss or Disturbance of California Least Tern Suitable Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
WILD-6: Loss of Suisun Song Sparrow and Salt Marsh Common Yellowthroat Suitable Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
WILD-7: Loss or Disturbance of Raptor Nest Sites or Foraging Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
WILD-8: Loss or Disturbance of Western Pond Turtle as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
WILD-9: Loss or Disturbance of Tricolored Blackbird as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
WILD-10: Effects on Southern Resident Killer Whales as a Result of Changes in Salmon Populations	A, B, C	No impact	–	–
WILD-11: Loss or Disturbance of Waterfowl and Shorebird Habitat as a Result of Tidal Wetland Restoration	A, B, C	Less than significant	None required	–
Managed Wetland Activities Impacts				
WILD-12: Loss or Disturbance of Salt Marsh Harvest Mouse Suitable Habitat as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-13: Loss or Disturbance of California Clapper Rail Suitable Habitat as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-14: Loss or Disturbance of California Black Rail Suitable Habitat as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-15: Loss or Disturbance of Suisun Shrew Suitable Habitat as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-16: Loss or Disturbance of California Least Tern Suitable Habitat as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measure	Significance after Mitigation
WILD-17: Loss or Disturbance of Suisun Song Sparrow and Salt Marsh Common Yellowthroat Suitable Habitat as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-18: Loss or Disturbance of Raptor Nest Sites or Foraging Habitat as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-19: Loss or Disturbance of Western Pond Turtle as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-20: Loss or Disturbance of Tricolored Blackbird as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-21: Effects on Southern Resident Killer Whales as a Result of Changes in Salmon Populations as a Result of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WILD-22: Changes in Waterfowl Nesting and Wintering Habitat as a Result of Marsh Management Activities	A, B, C	Beneficial	–	–
WILD-23: Changes in Shorebird Nesting and Wintering Habitat as a Result of Marsh Management Activities	A, B, C	Beneficial	–	–

Affected Environment

Definition of Study Area

The study area, as defined for this section, includes the four Suisun Marsh regions (Figure 1-3).

Sources of Information

Information sources used to prepare the affected environment section for wildlife include:

- previous studies conducted in the study area,
- published literature,
- *Draft Suisun Marsh Tidal Marsh and Aquatic Habitats Conceptual Model* (Conceptual Model 2010),
- *Conceptual Model for Managed Wetlands in Suisun Marsh* (California Department of Fish and Game 2007)
- CNDDB records search (California Natural Diversity Database 2010), and

- USFWS species list (Appendix C) (U.S. Fish and Wildlife Service 2010a).
- Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California (U.S. Fish and Wildlife Service 2010b).

Environmental Conditions

The study area consists of a mosaic of tidally influenced bays and sloughs and tidal wetland habitats, managed wetlands, and uplands (Table 6.2-2; Section 6.2, Vegetation and Wetlands). Managed wetlands make up approximately 51% of the total acreage in the study area and are primarily managed for wildlife, including but not limited to waterfowl production and overwintering habitat. Bays and sloughs (26%), tidal wetlands (7.5%), and upland (16%) are the other significant land cover types in the study area. Freshwater streams, seasonal wetlands, and riparian habitat also occur in the study area but account for only a small percentage of the overall area.

The following sections summarize the existing land cover types in the study area and identify special-status and common wildlife species that occur in the study area. Additional detailed information regarding the Suisun Marsh regions and the land cover types in the study area is provided in Section 6.2, Vegetation and Wetlands.

Land Cover Types

A land cover type represents the dominant features of the land surface and can be defined by natural vegetation, water, or human uses. Land cover types in the study area have been mapped and defined for numerous studies and documents. As a result, the definitions of the various land cover types vary slightly. For the purpose of this document, most land cover types were mapped by DFG (2000, 2004). Additional information on land cover types was reviewed in documents previously prepared for the Suisun Marsh region (California Department of Fish and Game, Wildlife Habitat Data Analysis Branch 2004; California Department of Water Resources 2001).

Historically Suisun Marsh consisted primarily of a mosaic of tidal wetland, dominated by saltgrass and pickleweed on the tidal plains and bulrushes along the slough margins (Suisun Marsh Ecological Workgroup 2001). The historic marshlands, bays, and sloughs were subject to daily tidal fluctuations and seasonal variations in water surface level resulting from inflows from the Sacramento and San Joaquin River systems.

Anthropogenic changes have affected the Marsh beginning with the use of fire by Native Americans to control the vegetation cover types. The most significant changes to the Marsh include the construction of dikes and ditches, the conversion of wetland habitat to agriculture and later to managed wetlands, sedimentation associated with hydraulic mining and other land uses that resulted in soil erosion, and the management of seasonal water inflow from Central Valley river systems.

In the study area, land cover types can be divided into natural vegetation communities, managed vegetation communities, aquatic communities, and developed land. The land cover types mapped in the study area are listed as habitat types in Table 6.2-2 and are discussed below. Table 6.2-2 also shows the extent of each habitat type as mapped throughout the study area. Waters of the United States have not been formally delineated as part of this plan. Waters of the United States, including wetlands, that are expected to fall under the jurisdiction of the Corps include bays and sloughs, tidal wetlands, and managed wetlands.

Bays and Sloughs

Bays and sloughs, as defined for this plan, include all areas of tidally influenced open water. Bays and sloughs make up approximately 25% of the total acreage in the study area (Table 6.2-2). Bays in the study area include the portions of Suisun and Honker Bay north of the Contra Costa County line, Grizzly Bay, and Little Honker Bay. Major sloughs in the study area are Suisun and Montezuma Sloughs. Minor sloughs are smaller channels that are hydrologically connected to the bays and major sloughs (Figure 5.6-3).

Bays and sloughs provide foraging habitat for several species of diving ducks, cormorants, grebes, and other waterfowl that are permanent residents or that winter in the study area. The upper reaches of the sloughs, composed of brackish or fresh water, provide foraging habitat for diving and dabbling ducks, other waterfowl species, kingfishers, and wading birds. Shallow freshwater aquatic areas provide rearing, escape cover, and foraging habitat for reptiles and amphibians and may be used as foraging habitat by river otter and raccoon.

Tidal Wetlands

Tidal wetlands in the study area consist of tidal wetlands that occur as relatively large tracts (complex tidal wetlands) or in narrow bands (fringing tidal wetlands), as described in Section 6.2, Vegetation and Wetlands.

Tidal wetlands are divided into three zones—low marsh, middle marsh, and high marsh. Historically, the high marsh was typically an expansive transitional zone between the tidal wetlands and adjacent uplands. The high marsh and associated upland transition zone have been affected significantly by land use changes (e.g., managed wetlands, agriculture).

The low tidal wetland occurs from the MLHW elevation to the MHW elevation. This zone receives tidal inundation once or twice per day. Plant zonation is influenced by inundation regime and salinity. The dominant plant species are hardstem bulrush and common bulrush. Other common species occurring in the low tidal wetland zone are pickleweed, low-club rush, common reed, and cattail (Suisun Marsh Ecological Workgroup 2001). The low tidal wetland zone provides foraging habitat for waterfowl and shorebirds, California clapper rail, California black rail, and other wading birds.

The middle tidal wetland occurs from MHW to MHHW. This zone receives tidal inundation at least once per day. Plant species composition and richness vary strongly with salinity and thus location in Suisun Marsh. Middle marsh elevations in brackish tidal wetlands often exhibit high plant species richness. The dominant plant species in this zone are pickleweed, saltgrass, and American bulrush. Other common species occurring in the middle tidal wetland are fleshy jaumea, sea milkwort, Baltic rush, salt marsh dodder, and alkali-heath, among others (Suisun Marsh Ecological Workgroup 2001; Conceptual Model 2010).

The middle tidal wetland zone provides foraging habitat for salt marsh harvest mouse and Suisun shrew, as well as common and special-status bird species, including waterfowl and shorebirds, California clapper rail, California black rail and other wading birds. This marsh zone also provides nesting and foraging habitat for Suisun song sparrow and salt marsh common yellowthroat.

The high tidal wetland occurs between approximately the MHHW elevation and the EHW elevation. This zone receives intermittent inundation during the monthly tidal cycle, with the higher elevations being inundated during only the highest tides. High tidal wetlands often accumulate the greatest portion of drift litter, which provides foraging and cover habitat for Suisun shrew (Conceptual Model 2010). The high tidal wetland provides escape cover for salt marsh harvest mouse and Suisun shrew, and California clapper rail during periods when the middle and lower portions of the high tidal wetland zone are inundated. The high marsh zone provides foraging and nesting habitat for special-status species such as salt marsh harvest mouse and Suisun shrew and provides foraging and nesting habitat for waterfowl, shorebirds, California clapper rail, California black rail, and other birds.

The upland transition occurs between the high wetland zone and adjacent uplands. This zone provides refuge for tidal wetland–dependent wildlife species during periods of extreme high tides and storm surges. It is generally dominated by a variety of plant species, including a mix of high tidal wetland zone species such as pickleweed and Baltic rush, as well as more upland species (Conceptual Model 2010).

Managed Wetlands

Managed wetlands are the most common land cover type in the study area, accounting for approximately 52,112 acres, or 51%, of the study area. The vegetation communities in the managed wetlands vary depending on the water management practices and the water source. In marshes with higher soil salinity, pickleweed, salt grass, and other salt-tolerant species are dominant. Alkali bulrush, cattail, and salt grass are common species in wetlands that use brackish water (California Department of Water Resources 2001; California Department of Fish and Game 2007). Watergrass and smartweed are typically the dominant species in managed wetlands that use fresher water. Pickleweed, fat hen, and brass buttons are common in the higher elevations of the managed wetlands. Other plant species that are important for waterfowl production and that occur in the managed wetlands are sea purslane, widgeongrass, sago pondweed, and swamp timothy.

Managed wetlands are a key component of the project site. The biodiversity of the Marsh can be attributed to the conservation efforts and long-term maintenance of the private and public lands.

Managed wetlands in the study area provide nesting, foraging, and wintering habitat for waterfowl and shorebirds and are managed to support waterfowl for hunting. Suisun Marsh is a key waterfowl wintering area in the Pacific Flyway (Suisun Marsh Ecological Workgroup 2001). Common wintering waterfowl include dabbling and diving ducks such as northern pintail (*Anas acuta*), mallard, green-winged teal (*Anas crecca*), American wigeon (*Anas americanus*), bufflehead (*Bucephala albeola*), and common goldeneye (*Bucephala clangula*) and geese such as white-fronted goose (*Anser albifrons*) and Canada goose (*Branta canadensis*). Managed wetlands provide nesting habitat for resident waterfowl, including mallard, pintail, cinnamon teal, northern shoveler, gadwall, and wood duck (California Department of Fish and Game 2007). Depending on the water management regime and time of year, shorebirds, waterfowl, and other wildlife depend on aquatic invertebrates found in this habitat.

Managed wetlands also provide foraging, nesting, and cover habitat for numerous wildlife species. Common resident and seasonal shorebirds include black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostra americanus*), black-bellied plover (*Pluvialus squatarola*), long-billed dowitcher (*Limnodromus scolopaceus*), long-billed curlew, greater yellowlegs, western sandpiper, and least sandpiper. Managed wetlands provide foraging habitat for several wading birds and water birds, including great blue heron, great egret, snowy egret, black-crowned night heron, double-crested cormorants, white pelicans, and American coot. Common passerine birds include Suisun song sparrow, Suisun common yellowthroat, marsh wren, red-winged blackbird, and Brewer's blackbird (California Department of Fish and Game 2007). Raptors that use managed wetlands for breeding and roosting include short-eared owl (*Asio flammeus*) and white-tailed kite (*Elanus leucurus*).

Managed wetlands also provide nesting and foraging area for several special-status species. Species use of these wetlands is dependent on the vegetation communities and water management cycles with any given managed wetland. Special-status species that may use managed wetlands are salt marsh harvest mouse, Suisun shrew, California black rail, western pond turtle, Suisun song sparrow, and salt marsh common yellowthroat. Managed wetlands provide breeding and resting habitat for short-eared owl and white-tailed kite. Managed wetlands also provide ecotone habitat for migratory and resident songbirds. Additionally, they provide seasonal habitat for numerous other common wildlife species such as pheasant, tule elk, coyote, beaver, river otter, skunk, raccoon, black-tailed jackrabbit, and long-tailed weasel.

Riparian Habitat

Riparian habitat that has been mapped in the study area is limited to small narrow bands of vegetation along sections of Suisun Creek and several unnamed drainages in the northwest portion of Region 1. Riparian habitat cover varies greatly with the land use and environmental characteristics. Although riparian habitat has been mapped only in Region 1, it is anticipated that riparian vegetation also occurs in small isolated areas throughout the Marsh in areas with suitable water availability, soil textures, and soil salinity gradients. However, the overall riparian cover in Suisun Marsh is low.

Mature riparian vegetation provides suitable nesting and roosting habitat for raptors, nesting and foraging habitat for migratory and resident songbirds, and roosting habitat for bats. Smaller riparian trees and shrubs also provide nesting and foraging habitat for migratory and resident songbirds. Riparian habitat also provides cover for common wildlife species, including mammals, reptiles, and amphibians.

Uplands

Upland habitats that occur in the SMP area include grassland and ruderal areas adjacent to the tidal and managed wetlands, and areas on the perimeter of the Marsh that are within the primary management zone. Uplands in the Marsh comprise annual grasslands, native perennial grasslands, coyote brush, agricultural areas, and disturbed areas dominated by ruderal herbaceous vegetation associated with the managed wetlands and other developed areas within the Marsh.

Uplands provide valuable wildlife habitat for reptiles, amphibians, and small and large mammals and nesting and foraging habitat for waterfowl, raptors, and several species of resident and wintering songbirds. Uplands present within the Marsh provide an extremely important ecotone or buffer zone between urban areas and wetlands. Mallards are the most common breeding waterfowl in the upland nesting areas. Other waterfowl species that use uplands are Canada goose, gadwall, northern pintail, and cinnamon teal. Common mammals include tule elk, ground squirrels, pheasant, coyote, skunk, raccoon, and black-tailed jackrabbit. Raptors that use uplands for breeding and roosting include short-eared owl, white-tailed kite, and northern harrier (*Circus cyaneus*). Several other raptors forage in upland habitat, including northern harrier, white-tailed kite, red-tailed hawk, American kestrel, and great-horned owl. Uplands also provide foraging and haul-out areas for several aquatic wildlife species, potential nesting habitat for western pond turtles, and high tide refugia for mammals otherwise preferring marsh habitat, such as the salt marsh harvest mouse.

Seasonal Wetlands and Vernal Pools

Only small areas of seasonal wetland and vernal pool complexes remain, and grazing has degraded much of the habitat. The seasonal wetland and vernal pool complexes remaining in the study area occur in the northern and eastern portions of the study area. These seasonal wetland complexes occur in the Potrero Hills and the south limits of the Montezuma Hills. Vernal pool critical habitat has been identified in the Potrero Hills. Seasonal wetland and vernal pools occur outside the limits of the managed wetlands and are not expected to be affected by implementation of the SMP.

Vernal pools and seasonal wetlands provide habitat for several species of vernal pool invertebrates as well as California tiger salamander. These wetlands provide foraging habitat for waterfowl and wading birds when the wetlands are inundated. Other common species may include: American avocet, black-necked stilt, long- and short-billed dowitchers, greater yellowlegs, godwit, long-billed curlew, killdeer, sandpipers, coot, rails, swallows, phoebes, finches, loggerhead shrikes, sparrows, meadowlarks, pheasants, doves, larks, and blackbirds. Important habitat also exists for reptile and amphibians such as fence lizard, gopher snake, garter snake, and western toad.The surrounding uplands provide nesting, foraging, and cover habitat for waterfowl as well as several species of songbirds.

Developed Land

Developed land mapped in the plan area includes areas with roads and buildings but also barren areas that have been disturbed and are unvegetated. Developed areas may also include areas of ornamental landscaping. Although developed areas are not a naturally occurring habitat, they provide additional habitat diversity in the project area that is used for nesting and shelter by a variety of resident and migrating birds. Eucalyptus trees can provide nesting habitat and foraging perches for different raptors, including red-shouldered hawk (*Buteo lineatus*), American kestrel (*Falco sparverius*), white-tailed kite (*Elanus lecurus*), and great horned owl (*Buteo virginianus*). Human-made structures such as pump houses, duck clubs, barns and outbuildings found in the project area may offer protection to nesting barn owl (*Tyto alba*), swallows (*Hirundinidae*), black phoebe, and roosting bats.

Special-Status Species

Special-status wildlife species are defined as species that are legally protected under ESA, the California Endangered Species Act (CESA), or other regulations and species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status wildlife species are:

- listed or proposed for listing as threatened or endangered under ESA (50 CFR 17.11 [listed wildlife], and various notices in the FR [proposed species]);
- candidates for possible future listing as threatened or endangered under ESA (66 FR 54808, October 30, 2001);
- listed or proposed for listing by the State of California as threatened or endangered under CESA (14 CCR 670.5);
- identified as species of general concern that have the potential to occur in the plan area because suitable or marginal habitat may exist for those species;
- identified as species of special concern to the DFG and Special Animals list (California Department of Fish and Game 2009) (mammals) that have the potential to occur in the plan area because suitable or marginal habitat may exist for those species;
- identified as species determined to meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380); or
- fully protected under California Fish and Game Code Section 3511(birds), Section 4700 (mammals), Section 5515 (fish), and Section 5050 (reptiles and amphibians).

This section provides a summary of the special-status species analysis for the study area. Special-status species that have the potential to occur in the study area were determined through a review of various sources, including a USFWS species list and the CNDDB (Table 6.3-2). Those species that are likely to occur in the study area and would be affected by SMP actions are further evaluated in this section. Those species that occur in habitats in the study area but would not be affected by SMP actions are not further evaluated in this section. For example, vernal pool–dependent species and several bat species are known to occur in the study area but will not be evaluated because habitat for these species would not be affected. Appendix D includes maps showing the locations of all CNDDB records for special-status species by Region in the study area.

Table 6.3-2. Special-Status Wildlife Species with the Potential to Occur in the Study Area

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Proposed for Evaluation in the EIR
MAMMALS					
Salt marsh harvest mouse *Reithrodontomys raviventris*	CE, FP	San Francisco, San Pablo, and Suisun Bays; western edge of the Delta.	Salt marshes with a dense plant cover of pickle-weed and fat hen; adjacent to an upland site.	Species observed in the study area. Suitable habitat in the study area.	Yes
San Joaquin kit fox *Vulpes macrotis mutica*	E/CT	Principally occurs in the San Joaquin Valley and adjacent open foothills to the west; recent records from 17 counties extending from Kern County to Contra Costa County.	Saltbush scrub, grassland, oak, savanna, and freshwater scrub.	Outside the species known range. No suitable habitat in the study area.	No
Suisun shrew *Sorex ornatus sinuosus*	–/CSC	Restricted to San Pablo Bay and Suisun Bay, both in Solano County.	Tidal, salt, and brackish marshes containing pickleweed, grindelia, bulrushes, or cattails; requires driftwood or other objects for nesting cover.	Species observed in the study area. Suitable habitat in the study area.	Yes
Western red bat *Lasiurus blossevillii*	–/CSC	Central and coastal California	Roosts in trees in forests or in scattered trees in grasslands	Species observed in the study area. Suitable habitat in the study area.	No
Townsend's Big-eared bat *Corynorhinus townsendii*	–/CSC	Western United States, northward to British Columbia, as far east as the Rocky Mountain States from Idaho to Texas, including Kansas and Oklahoma, and there are also populations in Arkansas, Missouri, Kentucky, Virginia, and West Virginia		One record in study area.	No
Hoary bat *Lasiurus cinerus*	–/CSC	Forested areas throughout most of California	Roosts in trees; typically in forests	One historic record in study area. May occur in study area during migration	No

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Proposed for Evaluation in the EIR
BIRDS					
California black rail *Laterallus jamaicensis coturniculus*	/CT, FP	Permanent resident in the San Francisco Bay and east-ward through the Delta into Sacramento and San Joaquin Counties; small populations in Marin, Santa Cruz, San Luis Obispo, Orange, Riverside, and Imperial Counties.	Tidal salt marshes associated with heavy growth of *Scirpus americanus* and pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations.	Species observed in the study area. Suitable habitat present in the study area.	Yes
California brown pelican *Pelecanus occidentalis californicus*	E/CE, FP	Present along the entire coastline, but does not breed north of Monterey County; extremely rare inland.	Typically in littoral ocean zones, just outside the surf line; nests on offshore islands.	May occur rarely in study area. Suitable foraging habitat in the study area.	No
California clapper rail *Rallus longirostris obsoletus*	E/CE, FP	Marshes around the San Francisco Bay and east through Suisun Marsh.	Restricted to salt marshes and tidal sloughs; usually associated with heavy growth of pickle-weed; feeds on mollusks removed from the mud in sloughs.	Species observed in the study area. Suitable habitat in the study area.	Yes
California least tern *Sterna antillarum browni*	E/CE, FP	Nests on beaches along the San Francisco Bay and along the southern California coast from southern San Luis Obispo County south to San Diego County.	Nests on sandy, upper ocean beaches, and occasionally uses mudflats; forages on adjacent surf line, estuaries, or the open ocean.	Species observed in the study area. Suitable habitat in the study area.	Yes
Cooper's hawk *Accipiter cooperii*	/–	Throughout California except high altitudes in the Sierra Nevada. Winters in the Central Valley, southeastern desert regions, and plains east of the Cascade Range.	Nests in a wide variety of habitat types, from riparian woodlands and digger pine-oak woodlands through mixed conifer forests.	May occur during migration or winter. Suitable foraging habitat present in the study area.	No
Ferruginous hawk *Buteo regalis*	/CSC	Does not nest in California; winter visitor along the coast from Sonoma County to San Diego County, east-ward to the Sierra Nevada foothills and south-eastern deserts, the Inyo-White Mountains, the plains east of the Cascade Range, and Siskiyou County.	Open terrain in plains and foothills where ground squirrels and other prey are available.	May occur during migration or winter. Suitable foraging habitat present in the study area.	No

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Proposed for Evaluation in the EIR
Great blue heron (rookery) *Ardea herodias*	–/SB	Common throughout most of California, less common mountains above the foothills.	Occurs in shallow estuaries and fresh and saline emergent wetlands, ponds and other slow moving waterways. Nests in colonies in tops of large snags or live trees.	Rookery sites present in the study area; however project actions would not affect this species because mature trees will not be removed and nearby work will occur outside the nesting season.	No
Northern harrier *Circus cyaneus*	/CSC	Occurs throughout lowland California. Has been recorded in fall at high elevations.	Grasslands, meadows, marshes, and seasonal and agricultural wetlands.	Species known to occur in the study area.	Yes
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	/CSC	Found only in the San Francisco Bay Area in Marin, Napa, Sonoma, Solano, San Francisco, San Mateo, Santa Clara, and Alameda Counties.	Freshwater marshes in summer and salt or brackish marshes in fall and winter; requires tall grasses, tules, and willow thickets for nesting and cover.	Species observed in the study area. Suitable habitat in the study area.	Yes
Short-eared owl *Asio flammeus*	/CSC	Permanent resident along the coast from Del Norte County to Monterey County although very rare in summer north of San Francisco Bay, in the Sierra Nevada north of Nevada County, in the plains east of the Cascades, and in Mono County; small, isolated populations.	Freshwater and salt marshes, lowland meadows, and irrigated alfalfa fields; needs dense tules or tall grass for nesting and daytime roosts.	Species observed in the study area. Suitable habitat in the study area.	Yes
Snowy egret (rookery) *Egretta thula*	–/SB	Occurs in the Central Valley, coastal lowlands, on the northeastern plateau and in the Imperial Valley.	Occurs in shallow estuaries and fresh and saline emergent wetlands, ponds and other slow moving waterways. Nests in colonies in tops of large snags or live trees.	Rookery sites present in the study area; however project actions would not affect this species because mature trees will not be removed and nearby work will occur outside the nesting season.	No

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Proposed for Evaluation in the EIR
Suisun song sparrow *Melospiza melodia maxillaris*	/CSC	Restricted to the extreme western edge of the Delta, between the cities of Vallejo and Pittsburg near Suisun Bay.	Brackish and tidal marshes supporting cattails, tules, various sedges, and pickleweed.	Species observed in the study area. Suitable habitat in the study area.	Yes
Swainson's hawk *Buteo swainsoni*	/CT	Lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley. Highest nesting densities occur near Davis and Woodland, Yolo County.	Nests in oaks or cottonwoods in or near riparian habitats. Forages in grasslands, irrigated pastures, and grain fields.	Species observed in the study area. Suitable habitat present in the study area.	Yes
Tricolored blackbird *Agelaius tricolor*	/CSC	Permanent resident in the Central Valley from Butte County to Kern County. Breeds at scattered coastal locations from Marin County south to San Diego County; and at scattered locations in Lake, Sonoma, and Solano Counties. Rare nester in Siskiyou, Modoc, and Lassen Counties.	Nests in dense colonies in emergent marsh vegetation, such as tules and cattails, or upland sites with blackberries, nettles, thistles, and grainfields. Habitat must be large enough to support 50 pairs. Probably requires water at or near the nesting colony.	Species observed in the study area. Suitable habitat present in the study area.	Yes
Western burrowing owl *Athene cunicularia hypugea*	/CSC	Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas. Rare along south coast.	Level, open, dry, heavily grazed or low stature grassland or desert vegetation with available burrows.	Species observed in the study area.	Yes
White-tailed kite *Elanus leucurus*	/FP	Lowland areas west of Sierra Nevada from the head of the Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border.	Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands for foraging.	Suitable habitat present in the study area.	Yes
REPTILES					
Alameda whipsnake *Masticophis lateralis euryxanthus*	T/CT	Restricted to Alameda and Contra Costa Counties; fragmented into 5 disjunct populations throughout its range.	Valleys, foothills, and low mountains associated with northern coastal scrub or chaparral habitat; requires rock outcrops for cover and foraging.	Outside the species known range.	No
Alameda whipsnake critical habitat				Outside the species known range.	No

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Proposed for Evaluation in the EIR
Giant garter snake *Thamnophis gigas*	T/CT	Central Valley from the vicinity of Burrel in Fresno County north to near Chico in Butte County; has been extirpated from areas south of Fresno.	Sloughs, canals, low gradient streams and freshwater marsh habitats where there is a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter.	Outside the species range. No suitable habitat in the study area.	No
Western pond turtle *Clemmys marmorata*	/CSC	Northwestern subspecies occurs from the Oregon border of Del Norte and Siskiyou Counties south along the coast to San Francisco Bay, inland through the Sacramento Valley, and on the western slope of Sierra Nevada. Southwestern subspecies occurs along the central coast of California east to the Sierra Nevada and along the southern California coast inland to the Mojave and Sonora Deserts; range overlaps with that of the northwestern pond turtle throughout the Delta and in the Central Valley.	Occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests. Woodlands, grasslands, and open forests; aquatic habitats, such as ponds, marshes, or streams, with rocky or muddy bottoms and vegetation for cover and food.	Species observed in the study area. Suitable habitat present in the study area.	Yes
AMPHIBIANS					
California red-legged frog *Rana aurora draytonii*	T/CSC	Found along the coast and coastal mountain ranges of California from Marin County to San Diego County and in the Sierra Nevada from Tehama County to Fresno County.	Permanent and semipermanent aquatic habitats, such as creeks and cold-water ponds, with emergent and submergent vegetation. May aestivate in rodent burrows or cracks during dry periods.	No suitable habitat in the study area.	No
California tiger salamander *Ambystoma californiense*	T/CSC	Central Valley, including Sierra Nevada foothills, up to approximately 1,000 feet, and coastal region from Butte County south to northeastern San Luis Obispo County.	Small ponds, lakes, or vernal pools in grass-lands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy.	No suitable habitat in the study area.	No

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Proposed for Evaluation in the EIR
INVERTEBRATES					
Antioch Dunes anthicid beetle *Anthicus anthiochensis*	/–	Population in Antioch Dunes believed extinct; Now known only from Grand Island and in and around Sandy Beach County Park, Sacramento County.	Loose sand on sand bars and sand dunes.	No suitable habitat in the study area.	No
Callippe silverspot *Speyeria callippe callippe*	E/–	San Bruno Mountain, San Mateo County, and a single location in Alameda County.	Open hillsides where wild pansy (*Viola pedunculata*) grows; larvae feed on Johnny jump-up plants, whereas adults feed on native mints and non-native thistles.	No suitable habitat in the study area.	No
Conservancy fairy shrimp *Branchinecta conservatio*	E–	Disjunct occurrences in Solano, Merced, Tehama, Ventura, Butte, and Glenn Counties.	Large, deep vernal pools in annual grasslands.	Suitable habitat present in the study area. Vernal pools will not be affected by the project.	No
Conservancy fairy shrimp Critical habitat *Branchinecta conservatio*	E/–			North of Potrero Hills in Secondary Management Area. Critical habitat would not be affected by the project.	No
Delta green ground beetle *Elaphrus viridis*	T/–	Solano County	Vernal pools in annual grasslands.	Outside the species known range.	No
Delta green ground beetle Critical habitat *Elaphrus viridis*				Study area is not within the area designated as critical habitat.	No
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T/–	Streamside habitats below 3,000 feet throughout the Central Valley.	Riparian and oak savanna habitats with elderberry shrubs; elderberries are the host plant.	Outside species range.	No
Valley elderberry longhorn beetle critical habitat *Desmocerus californicus dimorphus*				Study area is not within the area designated as critical habitat.	No

Species Name	Status[1] Fed/State	Distribution	Habitat	Likelihood of Occurrence in the Study Area	Proposed for Evaluation in the EIR
Vernal pool fairy shrimp *Branchinecta lynchi*	T/–	Central Valley, central and south Coast Ranges from Tehama County to Santa Barbara County. Isolated populations also in Riverside County.	Common in vernal pools; also found in sandstone rock outcrop pools.	Suitable habitat present in the study area. Vernal pools will not be affected by the project.	No
Vernal pool fairy shrimp critical habitat				In Potrero Hills in Secondary Management Area. Critical habitat would not be affected by the project.	No
Vernal pool tadpole shrimp *Lepidurus packardi*	E/–	Shasta County south to Merced County.	Vernal pools and ephemeral stock ponds.	Suitable habitat present in the study area. Vernal pools will not be affected by the project.	No
Vernal pool tadpole shrimp critical habitat				In Potrero Hills in Secondary Management Area. Critical habitat would not be affected by the project.	No
California freshwater shrimp *Syncaris pacifica*	E/CE	Marin, Napa, and Sonoma Counties.	Perennial freshwater streams	No suitable habitat in the study area.	No

Species listed in table are generated from the U.S. Fish and Wildlife Service (USFWS) project species list, California Department of Water Resources (DWR) field survey data, and California Natural Diversity Database (CNDDB) records. Species shown in highlight are species covered under the CALFED Bay-Delta Program (CALFED) programmatic biological opinions and the Natural Community Conservation Plan (NCCP) determination.

[1] Status:

Federal

E = Listed as endangered under the federal Endangered Species Act (ESA).

T = Listed as threatened under ESA.

– = No federal status.

State

CE = Listed as endangered under the California Endangered Species Act (CESA).

CT	=	Listed as threatened under CESA.
CSC	=	California species of special concern.
FP	=	Fully protected under California Fish and Game Code.
SB	=	Specified birds under California Fish and Game Code.
–	=	No state status.

Special-Status Species in the Study Area

The following sections describe special-status species that are known or are likely to occur in the study area. The following information is provided for each species:

- habitat requirements,
- suitable land cover types (habitats) available for each species in the study area,
- surveys performed for the species in the study area, and
- status of each species in the study area.

The special-status species listed in Table 6.3-2 include 14 species that are likely to occur or have been observed in the study area. Several of these species are known to occur in the study area. The other species are not known to occur in the study area, but they historically have occurred in the study area, and the study area contains breeding or nonbreeding habitat for these species. Table 6.3-3 identifies the habitat types used by each of these species in the study area.

The 14 species with potential to occur in the study area are:

- salt marsh harvest mouse,
- California clapper rail,
- California black rail,
- Suisun shrew,
- California least tern,
- Suisun song sparrow,
- salt marsh common yellowthroat,
- western pond turtle,
- tricolored blackbird,
- western burrowing owl,
- short-eared owl,
- northern harrier,
- white-tailed kite, and
- Swainson's hawk.

Managed wetlands were designed primarily to preserve and enhance habitat for migratory waterfowl; however, they also provide ancillary benefits for other wildlife and wetland-dependent species (e.g., salt marsh harvest mouse, Suisun shrew, short-eared owl). Much of the public land within the Marsh, including

Grizzly Island Wildlife Area, is managed to conserve and enhance diversity among all wildlife, fish, and special-status species. Table 6.3-3, below, shows all the special-status species in the Marsh and which habitats they use. Table 6.3-4 identifies the season in which special-status species are known to occur in the study area.

Table 6.3-3. Habitat Preferences of Special-Status Wildlife Species in Suisun Marsh

	Habitat									
		Tidal Wetland								
Species	Bays and Sloughs	Low Tidal Zone	Middle Tidal Zone	High Tidal Zone	Upland Transition Zone[2]	Managed Wetland	Upland	Riparian	Seasonal Wetland and Vernal Pool	Developed
Western pond turtle[1]	R, F, B	–	–	–	–	R, F, B	R, B	–	–	–
Salt marsh harvest mouse	–	–	R, F, B	R, F, B	R	R, F, B	–	–	–	–
Suisun shrew	–	–	R, F, B	R, F, B	R, F, B	R, F, B	–	–	–	–
California clapper rail	–	F	R, F, B	R, F, B	R	–	–	–	–	–
California black rail	–	–	F	R, F, B	R	R, F, B	–	–	–	–
California least tern[3]	F	F	F	F	R, B	F	R, B	–	–	–
Suisun song sparrow	–	F	R, F, B	R, F, B	R	R, F, B	F	–	–	–
Salt marsh common yellowthroat	–	F	R, F, B	R, F, B	R	R, F, B	–	–	–	–
Tricolored blackbird	–	–	–	R,F, B	–	R, F, B	F	R, F	–	–
Western burrowing owl	–	–	–	–	–	–	R, F, B	–	–	–
Short-eared owl	–	–	–	F	F	F	R, F, B	–	–	–
Northern harrier	–	–	–	F	F	R, F, B	R, F, B	–	–	–
White-tailed kite	–	–	–	–	–	R, F, B	R, F, B	R, B	–	–
Swainson's hawk	–	–	–	–	–	–	F	R, B	–	–

Source: Information obtained from Goals Project 1999 (additional information provided by ICF International).

R: resting

F: foraging

B: breeding

1 Western pond turtle are restricted to freshwater portions of sloughs.

2 The upland transition zone provides refugia from high water events for several species.

3 California least tern may forage in tidal wetlands when they are inundated.

Table 6.3-4. Wildlife Life Stage Timing in Suisun Marsh

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Salt Marsh Harvest Mouse												
Breeding and Rearing			■	■	■	■	■	■	■	■	■	
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
California Clapper Rail												
Breeding and Rearing		■	■	■	■	■	■	■				
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
California Black Rail												
Breeding and Rearing			■	■	■	■	■					
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
Suisun Shrew												
Breeding and Rearing				■	■	■	■	■	■	■		
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
California Least Tern												
Breeding and Rearing					■	■	■	■				
Foraging					■	■	■	■				
Suisun Song Sparrow												
Breeding and Rearing			■	■	■	■	■					
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
Salt Marsh Common Yellowthroat												
Breeding and Rearing			■	■	■	■	■					
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
Tricolored Blackbird												
Breeding and Rearing			■	■	■	■	■					
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
Western Pond Turtle												
Breeding and Rearing				■	■	■	■					
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
Waterfowl (Managed Wetland Spp.)												
Breeding and Rearing			■	■	■	■	■	■				
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
Shorebirds												
Breeding and Rearing				■	■	■	■	■				
Foraging	■	■	■	■	■	■	■	■	■	■	■	■
Raptors												
Breeding and Rearing		■	■	■	■	■	■	■				
Foraging	■	■	■	■	■	■	■	■	■	■	■	■

Sources: Marschalek 2007; Suisun Ecological Workshop 2001.

Salt Marsh Harvest Mouse

Salt marsh harvest mouse (*Reithrodontomys raviventris* ssp. *raviventris*) is federally and state-listed as endangered (FR 35:16047; October 13, 1970) and is fully protected under Fish and Game code. Critical habitat has not been designated for this species. The northern subspecies inhabits the Suisun Bay and San Pablo Bay regions. A recovery plan for this species was prepared by the USFWS in 1984 and updated in the Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California in 2010 (U.S. Fish and Wildlife Service 2010b).

Thirteen areas on state lands have been set aside in the Marsh, totaling more than 2,500 acres, to conserve habitat for salt marsh harvest mouse and other wetland dependent species. The salt marsh harvest mouse preserves are Peytonia Slough; Hill Slough West Ponds 1, 2, 4, and 4A; Hill Slough East Areas 8 and 9; a portion of Joice Island, Crescent Unit, a portion of Lower Joice Island; Blacklock; and Grizzly Island Ponds 1 and 15. Mitigation areas are Island Slough Ponds 4 and 7.

Salt marsh harvest mice are dependent on dense cover, including that provided by pickleweed- or non-pickleweed-dominated mixed wetlands. Mixed stands of native salt marsh vegetation dominated by pickleweed have higher habitat value than pure stands (Conceptual Model 2010). As such, habitat complexity in the form of other halophytes such as chairmaker’s bulrush, fat hen, alkali heath, and other species that provide vertical habitat complexity is also preferred (U.S. Fish and Wildlife Service 1984). Studies by DFG have identified that salt marsh harvest mouse populations in Suisun Marsh frequently used bulrush (Sustaita et al. 2010). Salt marsh harvest mice use the higher tidal wetland and upland transitional zone as ecape cover from high tides. Nests are minimal and constructed of loose grass and vegetative matter that is placed on the ground or over old bird nests (U.S. Fish and Wildlife Service 1984). Harvest mice feed on vegetation and seeds as well as insects (Jameson 1988).

There are 42 documented CNDDB occurrences of salt marsh harvest mouse in the Marsh (California Natural Diversity Database 2010) (Appendix D). This species has been observed in tidal wetlands and along sloughs as well as within managed wetlands. Suitable habitat for harvest mice in the managed wetlands, in terms of halophytic species, typically occurs at the higher elevations in the wetlands or in wetlands with higher soil salinity.

Suisun Shrew

Suisun shrew (*Sorex ornatus sinuosus*) is a state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated.

Suisun shrews occur in tidal wetlands in Suisun Bay, Grizzly Island, and San Pablo Bay (Jameson 1988). Suisun shrews require areas of fairly constant soil moisture with dense, low-lying plant cover, and abundant invertebrates (Conceptual Model 2010). This species occupies the same middle and high marsh zone habitat as the salt marsh harvest mouse (Williams 1986). Driftwood and organic litter above the high tide inundation zone may be used for nesting and foraging. Suisun shrews excavate or may use existing subterranean burrows as movement corridors and for foraging (California Department of Water Resources 2001). Suisun shrews use the higher tidal wetland zones and upland transition zones as escape cover from high tides. Suisun shrews feed on invertebrates and small crustaceans (Jameson 1988).

There are six documented CNDDB occurrences of Suisun shrew in the study area (California Natural Diversity Database 2010) (Appendix D). This species has been observed in tidal wetlands and in managed wetlands. Occurrences were documented in Grizzly Island, Cordelia Salt Marsh, Cutoff Slough, Hill Slough, and Suisun Slough.

California Clapper Rail

California clapper rail (*Rallus longirostris obsoletus*) is federally and state-listed as endangered (FR 35:16047; October 13, 1970) and is also a fully protected species under Fish and Game Code Section 3511. Critical habitat has not been designated for this species. A recovery plan for this species was prepared by the USFWS in 1984 and updated in the Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California in 2010 (U.S Fish and Wildlife Service 2010b).

Historically, the salt marshes of San Francisco Bay supported the largest populations of California clapper rail in the state. Populations also were recorded in coastal marshes from San Luis Obispo County to Humboldt County. Presently, this species is known to occur only in the marshes of San Francisco Bay, San Pablo Bay, and Suisun Bay.

California clapper rails occur in tidal saline and brackish sloughs and tidal wetlands (U.S. Fish and Wildlife Service 1984) typically dominated by pickleweed and other halophytic species. Clapper rails are most often found in larger marshes and close to other large marshes and prefer marshes with established vegetative cover. Habitat that has direct tidal circulation, abundant high marsh cover, and an intricate network of tidal sloughs that provide abundant invertebrate populations is preferred. Other factors that affect rail use of tidal wetlands are inundation regime, access to high ground refugia, salinity, and vegetation communities (Conceptual Model 2010).

In the study area, the California clapper rail historically has been restricted to the western, more saline portions of Suisun Marsh. The intertidal zone may provide marginal foraging habitat for California clapper rail. The low and middle tidal wetland zones may be used for foraging and refugial habitat. High tidal wetland zones provide optimal foraging, refugial, and nesting habitat. The upland transition zone provides escape cover from high tides (Conceptual Model 2010).

Nests are located in dense wetland vegetation and are constructed off the ground and above the high tide elevation. The nests typically are constructed of cordgrass or other vegetation and are capped with vegetation (Lewis and Garrison1983). California clapper rails feed primarily on mollusks, crustaceans, and aquatic and terrestrial invertebrates along tidal sloughs and marshes. California clapper rails in the study area are found primarily in vegetation that includes bulrush, cattail, and silverweed (*Potentilla anserina*) (California Department of Fish and Game 2000, 2004).

There are 14 documented CNDDB occurrences of California clapper rail in the study area (California Natural Diversity Database 2010) (Appendix D). This species has been detected at several locations in Suisun Marsh, including occurrences along Suisun Slough, Cutoff Slough, Hill Slough, Goodyear Slough, and Ryer Island. As few as four clapper rails were detected in the study area during the breeding season in seven survey years from 2002 to 2008; however, eight were detected during the fall of the same years (California Department of Fish and Game 2007; unpublished California Department of Fish and Game survey 2008). Surveys conducted by DFG in 2006 identified two clapper rail occurrences in the Marsh and three occurrences near Point Edith on the south side of Grizzly Bay. The two occurrences in the Marsh were from First Mallard Slough (California Department of Fish and Game 2007).

California Black Rail

California black rail (*Laterallus jamaicensis coturniculus*) is state-listed as threatened (California Natural Diversity Database 2010) and is also a fully protected species under Fish and Game Code Section 3511. There is no federal listing for this species, and critical habitat has not been designated. California black rails are small birds, approximately the size of a sparrow, and are year-round residents of the study area.

California black rails occur along tidal sloughs, brackish marsh, and tidal wetlands and typically occur in marshes dominated by pickleweed or low-growing forms of bulrush (Manolis 1978). California black rails are associated with habitat features representative of mature, well-developed marshes. Black rails most often are found in larger marshes and close to other large marshes. California black rails require high marshes with moist soil and shallow water. Other factors that affect black rail use of tidal wetlands are inundation regime and marsh geomorphology, stable water levels that seldom flood, dense stands of low growing vegetation, and access to high-ground refugia (Conceptual Model 2010).

Diked marshes do not appear to provide suitable breeding habitat, possibly because they have lower food resource levels than tidal wetlands (Manolis 1978). California black rail nests are located in the high marsh zone and occasionally the upper limits of the middle marsh zone above the limits of tidal inundation. Nests are constructed of loosely placed vegetation concealed in dense marsh vegetation. California black rails feed primarily on invertebrates.

California black rails occur primarily in tidal salt marshes in the northern San Francisco Bay region, including the Delta, Suisun Bay, and San Pablo Bay. Smaller populations occur in San Francisco Bay, coastal Marin County, freshwater marshes of the Sierra Nevada, and along the lower Colorado River (Spautz et al. 2005). Surveys conducted in the San Francisco Bay region in 1977 identified 32 occurrences, 22 in the San Pablo Bay region and 7 in the Suisun Bay region (Manolis 1978). Surveys conducted in 2001 (Spautz et al. 2005) estimated the black rail population in the Suisun Bay region to be approximately 12,000 (range 6,700–17,200).

There are 18 documented CNDDB occurrences of California black rail in the study area (California Natural Diversity Database 2010) (Appendix D). These occurrences were from Peytonia, Cutoff, Hill, Goodyear, Suisun, Denverton, and Boynton Sloughs, and Roe and Ryer Islands. The vegetation communities associated with these occurrences were tidal brackish marsh dominated by pickleweed, bulrush, and other halophytes. Breeding season surveys conducted in 2006 identified 60 occurrences of California black rail in the study area (California Department of Fish and Game 2007).

California Least Tern

California least tern (*Sternula antillarium browni*) is federally and state-listed as endangered (California Natural Diversity Database 2010) and is also fully protected underFish and Game code. USFWS recommends changing the California least tern's status to threatened (U.S. Fish and Wildlife Service 2007). Critical habitat has not been designated for this species. The USFWS published a recovery plan for this species in 1985 (U.S. Fish and Wildlife Service 1985).

California least tern occurs along the Pacific Coast from San Francisco Bay to Baja California. These birds forage by hovering over and diving into water to catch fish, shrimp, and sometimes other invertebrates (U.S. Fish and Wildlife Service 2007). They forage over shallow to deep water, and also may skim tidal pools on mudflats to capture prey. Nests consist of shallow scrapes in sand or fine substrate gravel with sparse vegetation near open water along coastal beaches and estuaries (U.S. Fish and Wildlife Service 1985).

There is one documented CNDDB occurrence of California least tern in the study area (California Natural Diversity Database 2010) (Appendix D). A breeding colony was located on the east side of Montezuma Slough near Collinsville in 2006 at a dredge spoils disposal site.

Suisun Song Sparrow

Suisun song sparrow (*Melospiza melodia maxillaris*) is a state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated. The Suisun song sparrow is a distinct subspecies of song sparrows and is completely endemic to Suisun Bay (Conceptual Model 2010).

Suisun song sparrows are permanent residents and generally favor well-developed middle and high marsh zones characterized by bulrush, cattail, and other emergent marsh vegetation. Suisun song sparrow also has been observed in distribution channels, permanent ponds, and other managed wetlands within the study area that provide the required vegetation communities and brackish water conditions (Conceptual Model 2010). Suisun song sparrow nests are located in the marsh vegetation above the limits of tidal inundation. Suisun song sparrows forage on the ground and on the mudflats in the high marsh zone. Their diet consists of invertebrates and seeds (California Department of Water Resources 2001).

There are 19 documented CNDDB occurrences of Suisun song sparrow in the study area (California Natural Diversity Database 2010) (Appendix D). Several hundred Suisun song sparrows were detected in 2005 during point count surveys at eight locations in the study area (Liu et al. 2005). This species has been observed in tidal wetlands and in managed wetlands.

Salt Marsh Common Yellowthroat

Salt marsh common yellowthroat (*Geothylpis trichus sinuosa*) is a state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated. The salt marsh common yellowthroat is one of four subspecies that occur in California. The range of this subspecies includes Tomales Bay to the north, Suisun Bay to the east and Santa Cruz County to the south (Foster 1977).

Salt marsh common yellowthroats are permanent residents and occur in tidal and brackish marshes and managed wetlands in the study area. This species occupies marshes characterized by bulrush, cattail, pickleweed, and other emergent marsh vegetation. Salt marsh common yellowthroat nests are located in the marsh vegetation above the limits of tidal inundation. Salt marsh common yellowthroat is insectivorous and forages in emergent wetland vegetation. Their diet consists of invertebrates and seeds (California Department of Water Resources 2001).

There are 13 documented CNDDB occurrences of salt marsh common yellowthroat in the study area (California Natural Diversity Database 2010) (Appendix D). In addition to the CNDDB records, several hundred salt marsh common yellowthroat were observed during breeding bird surveys performed by the Point Reyes Bird Observatory (PRBO) between 2003 and 2006 (Point Spautz et al. 2003; Herzog et al. 2004; Liu et al. 2006; Liu et al. 2007). Several hundred salt marsh common yellowthroat were observed in 2005 during point count surveys at eight locations in the study area (Point Reyes Bird Observatory 2006). This species has been observed in tidal wetlands and in managed wetlands throughout the study area.

Western Pond Turtle

Western pond turtle (*Actinemys marmorata*) is a state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated.

Western pond turtles inhabit permanent or nearly permanent waters with little or no current and suitable salinity gradients (Behler and King 1998). The channel banks of inhabited waters usually have thick vegetation, but basking sites such as logs, rocks, or open banks also must be present (Zeiner et al. 1988). In Suisun Marsh, the upper reaches of tidal sloughs and the managed wetlands provide suitable habitat. Eggs are laid in nests in upland areas. Nest sites typically are found on a slope that is unshaded and has a high clay or silt composition and in soil at least 4 inches deep (Jennings and Hayes 1994).

Although there are only two documented CNDDB occurrences of western pond turtles in the study area (California Natural Diversity Database 2010) (Appendix D), this species is common and is known to occur in suitable habitat (e.g., permanently flooded water supply ditches).

Tricolored Blackbird

Tricolored blackbird (*Agelaius tricolor*) is a state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated.

Tricolored blackbirds are permanent residents of the Sacramento–San Joaquin Valley. This species nests in colonies in large, dense stands of tule, cattail, Himalayan blackberry thickets, and fallow fields (California Department of Water Resources 2001). Suitable nesting habitat in extensive stands of emergent wetland vegetation is associated with tidal and brackish wetlands and managed wetlands. Tricolored blackbirds feed on insects and seeds and may forage in agricultural and pasture lands, grasslands, and the margins of managed wetlands in the study area.

There is one historical documented CNDDB occurrence of tricolored blackbird in the Region 2 of the study area (Appendix D). This occurrence is now believed to be extirpated (California Natural Diversity Database 2010). Tricolored blackbirds were observed in the Potrero Hills in 2000 and 2003 (Solano County 2006). Approximately 200 birds also were observed at Rush Ranch in 2008.

Western Burrowing Owl

Western burrowing owl (*Athene cunicularia*) is a state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated.

Western burrowing owls are permanent residents in the study area. Suitable habitat occurs in upland habitats and in the vicinity of agricultural lands throughout the study area. The western burrowing owl nests and roosts in abandoned ground squirrel and other small-mammal burrows (Zeiner et al. 1990) as well as artificial burrows (e.g., culverts, concrete slabs, and debris piles). The breeding season is from March to August, peaking in April and May.

There are five documented occurrences of western burrowing owl in the study area (California Natural Diversity Database 2010) (Appendix D). This species has been observed in upland habitats in the northern portion of the Marsh, including the Potrero Hills, and on the east side of Montezuma Slough near Collinsville Road. This species is expected to occur in suitable habitat throughout the study area.

Short-Eared Owl

Short-eared owl (*Asio flammeus*) is a state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated.

Historically, short-eared owls bred throughout California. Breeding populations of short-eared owls have been extirpated from the San Joaquin Valley (Remsen 1978); however, this species is a permanent resident and still breeds in the southern portion of the Sacramento Valley (Yolo and Solano Counties), the Delta, and Suisun Marsh. Short-eared owls nest in upland portions of Suisun Marsh and also occur in the study area during the winter months with migrating birds arriving in September and October and leaving in April (Zeiner et al. 1990). Nests are built on the ground in tall stands of grasses in lowland habitats in marshes, meadows, and even agricultural fields. These lowland nesting habitats are situated near hunting grounds (Grinnell and Miller 1944).

There is one documented CNDDB occurrence of short-eared owl in the study area (California Natural Diversity Database 2010) (Appendix D, Region 2). Nesting short-eared owls have been observed over the last 20 years on Grizzly Island during waterfowl nesting surveys. A Jones & Stokes biologist also observed a short-eared owl on Grizzly Island during a 1996 survey. This species is expected to occur in suitable habitat throughout the study area.

Northern Harrier

Northern harrier (*Circus cyaneaus*) is a state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated.

Northern harriers are permanent residents of the study area, and the breeding range of the Delta population includes most of the Central Valley, the Delta, Suisun Marsh, and portions of San Francisco Bay (Zeiner et al. 1990). Northern harrier nest and roost in herbaceous vegetation in wetlands and field borders (Zeiner et al. 1990). It will roost on the ground in shrubby vegetation, often near the marsh edge (Brown and Amadon 1968). Foraging habitat in the study area includes tidal and brackish marshes, managed wetlands, agricultural lands, and pasturelands.

There is one documented CNDDB occurrences of northern harriers in the study area (California Natural Diversity Database 2010). This species is known to occur in suitable habitat throughout the study area. Nesting harriers have been observed over the last 20 years on Grizzly Island during waterfowl nesting surveys in upland portions of Suisun Marsh. This species also has been observed by DFG and DWR personnel.

White-Tailed Kite

White-tailed kite (*Elanus leucurus*) is a fully protected state species of special concern (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated.

White-tailed kites are permanent residents in the study area and may inhabit ruderal habitat, managed wetlands, and agricultural and pasture lands. Some large trees or shrubs are required for nesting; therefore, nesting may be limited throughout much of the study area.

There is one documented CNDDB occurrence of white-tailed kite in the study area (California Natural Diversity Database 2010) (Appendix D); however, this species is known to occur in suitable habitat throughout the study area. Nesting kites have been observed over the last 20 years on Grizzly Island during waterfowl nesting surveys in upland portions of Suisun Marsh.

Swainson's Hawk

Swainson's hawk (*Buteo swainsonii*) is state-listed as threatened (California Natural Diversity Database 2010). There is no federal listing for this species, and critical habitat has not been designated.

Swainson's hawks are summer residents in California and small numbers of this species are known to winter in the Delta. Swainson's hawks nest primarily in riparian areas adjacent to agricultural fields or pastures, although they sometimes use isolated trees or roadside trees (California Department of Fish and Game 1994). Nest sites typically are located in the vicinity of suitable foraging areas. The primary foraging areas for Swainson's hawk are open agricultural lands and pastures (California Department of Fish and Game 1994).

There is one documented CNDDB occurrence of Swainson's hawk in the study area (California Natural Diversity Database 2010) (Appendix D). This occurrence, in 2004, was an active nest located in riparian vegetation along Cordelia Slough. This species may occur only in small numbers in the study area because of the lack of suitable nesting and foraging habitat.

Waterfowl

The study area provides nesting, foraging, and wintering habitat for waterfowl, and Suisun Marsh is a key waterfowl wintering area in the Pacific Flyway. The large expanses of managed wetlands provide nesting and foraging habitat for resident and migratory species. Tidal and brackish wetland, bays, and sloughs of Suisun Marsh also provide habitat for waterfowl. One-day winter counts commonly tally more than 125,000 waterfowl (Suisun Marsh Ecological Workgroup 2001). The common waterfowl species known occur in the Marsh, and the habitats in which they occur, are identified in Table 6.3-5.

Table 6.3-5. Habitat Use by Waterfowl

Species	Managed Wetland	Tidal Wetland	Bays and Sloughs
Waterfowl—Dabbling Ducks			
Mallard	F, L, B	F,L	FL
Gadwall	F, L, B	F,L	F,L
Green-winged teal	F, L		
American widgeon	F, L	F,L	F,L
Northern pintail	F, L, B	F,L	F,L
Northern shoveler	F, L, B	F,L	F,L
Cinnamon teal	F, L, B		
Wood duck	F, L, B		
Waterfowl—Diving Ducks			
Ruddy duck	F, L, B	F,L	F, L
Canvasback	F, L	F,L	F, L
Redhead	F, L	F,L	F, L
Ring-necked duck	F, L	F,L	F, L
Greater scaup	F, L	F,L	F, L
Lesser scaup	F, L	F,L	F, L
Black scoter			F, L
Surf scoter			F, L
White-winged scoter			F, L
Barrow's goldeneye	F, L	F,L	F, L
Common goldeneye	F, L	F,L	F, L
Bufflehead	F, L	F,L	F, L
Common merganser	F, L		
Waterfowl—Geese			
Canada Goose	F, L, B	F,L,B	
Greater white-fronted goose	F, L	F,L	
Tule white-fronted goose	F, L		
Snow goose	F, L		
Ross' goose	F, L		
Waterfowl—Swans			
Tundra swan	F, L	F,L	
F: foraging; L: loafing; B: breeding.			

Common wintering waterfowl include both dabbling and diving ducks such as mallard, northern pintail (*Anas acuta*), American wigeon (*Anas americanus*), bufflehead (*Bucephala albeola*), and common goldeneye (*Bucephala clangula*) and geese such as white-fronted goose (*Anser albifrons*) and Canada goose (*Branta canadensis*).

Suisun Marsh also supports a high level of waterfowl production. A study by McLandress et al. (1996) found mallard nest density was 4 to 23 times the density in other areas of California (California Department of Water Resources 2001). Mallard, gadwall (*Anas strepera*), northern shoveler (*Anas clypeata*), northern pintail, cinnamon teal (*Anas cyanoptera*), wood duck (*Aix sponsa*), ruddy duck (*Oxyura jamaicensis*), and Canada goose are also known to nest in the study area.

The value of individual managed wetlands to waterfowl production and overwintering habitat varies depending on water management practices, soil salinity, and the associated plant communities. The goal of most managed wetlands in Suisun Marsh is to provide wintering habitat for waterfowl (California Department of Water Resources 2001). Wetland managers usually begin flooding their ponds in early October, and drainage of the ponds begins after the waterfowl season ends in January. Most ponds in the Marsh are completely drained by June. Vegetation composition is controlled by soil salinity, water management, and mechanical vegetation control (e.g., disking).

Taxonomically, migratory waterfowl using Suisun managed wetlands for wintering habitat are, dabbling ducks, diving ducks (or bay ducks), sea ducks, stiff-tailed ducks, geese, and swans (Conceptual Model 2010). For the purpose of this document diving ducks will include those species taxonomically considered diving ducks as well as sea ducks and stiff-tailed ducks. Table 6.3-5 identifies the waterfowl species known to occur in Suisun Marsh, the season and land cover type in which these species typically occur, and habitat function provided by the land cover types.

Dabbling Ducks

Suisun Marsh provides foraging habitat for resident, migratory, and wintering dabbling ducks. Dabbling ducks are omnivorous, and dietary preferences vary by species. Dabbling ducks feed primarily on seeds. Dabbling ducks forage primarily in managed wetlands but also may forage in tidal wetlands. Resident species known to nest in the study area include mallard, gadwall, northern shoveler, northern pintail, and cinnamon teal. Migratory and wintering dabbling ducks also include green-winged teal, and American wigeon.

Diving Ducks

The bays, sloughs, tidal wetlands, and managed wetlands of Suisun Marsh provide important foraging habitat for diving ducks. Diving ducks that occur in the study area include bufflehead, common goldeneye, Barrow’s goldeneye, canvasback, redhead, ring-necked duck, great scaup, lesser scaup, common merganser, black scoter, surf scoter, white-winged scoter, and ruddy duck. Habitat preferences vary by species. All of these species, with the exception of greater scaup, forage in tidal wetlands, bays, and sloughs. Other species such as bufflehead, common goldeneye, and ruddy duck commonly forage in managed wetlands. Their use of managed wetlands is dependent on water depths and vegetation cover. Diving ducks feed on benthic organisms and fish, with dietary requirements varying by species.

Geese

Several goose species occur in the study area. The most common species observed are Canada geese (*Branta canadensis*), tule greater white-fronted geese (*Anser albifrons*), and snow geese (*Chen caerulescens*). Other geese known to occur in the study area are cackling Canada goose, greater white-front goose, and Ross' goose (Conceptual Model 2010). Geese graze on grains and foliage in the winter and also are known to occur in managed wetlands. Canada goose is the only nesting species in Suisun Marsh.

Swans

The tundra swan (*Cygnus columbianus*) winters in the study area. Tundra swans feed by dabbling in waters up to 3 feet in depth and also forage on grains. They feed primarily on seeds, stems, roots and tubers of submerged and emergent vegetation (Conceptual Model 2010). Tundra swans in Suisun Marsh typically occur in managed wetlands but also may use tidal wetlands.

Shorebirds

The tidal wetlands and managed wetlands in the study area provide habitat for several species of shorebirds, particularly migrating and overwintering birds. Managed wetlands make up approximately 67% of all bay land habitat in Suisun Bay (Hickey and W.D. Shuford 2003). The value of these wetlands to shorebirds varies depending on water level, salinity, and the vegetation communities present. These wetlands provide foraging habitat for the black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostra americana*), greater yellowlegs (*Tringa melanoleuca*), dunlin (*Calidris alpine*), and long-billed dowitcher (*Limnodromus scolopaceus*) and nesting habitat for the killdeer (*Charadrius vociferous*), black-necked stilt, and American avocet (Hickey and W.D. Shuford 2003). The common shorebird species that occur in the Marsh and the habitats in which they occur are identified in Table 6.3-6.

Table 6.3-6. Habitat Use by Shorebirds

Species	Tidal Areas (Mud Flats)	Managed Wetland
Shorebirds—Probers		
Semipalmated plover	F, L	F, L
Killdeer	F, L	F, L, B
Black-bellied plover	F, L	F, L
Marbled godwit	F, L	F, L
Long-billed curlew	F, L	F, L
Willet	F, L	
Greater yellowlegs	F, L	F, L
Lesser yellowlegs	F, L	F, L
Short-billed dowitcher	F, L	F, L
Long-billed dowitcher	F, L	F, L
Wilson's snipe	-	F, L
Dunlin	F, L	F, L
Western sandpiper	F, L	F, L
Least sandpiper	F, L	F, L
Shorebirds—Sweepers		
American avocet	F, L	F, L, B
Black-necked stilt	F, L	F, L, B
Wilson's phalarope	F, L	F, L
Red-necked phalarope	F, L	F, L

F: foraging; L: loafing; B: breeding.

Shorebirds include shallow and deep probers and shallow feeders. Probers forage by probing saturated or ponded substrates for invertebrates, crustaceans, and insects. The depth of available foraging substrate is dependent on bill length. Shallow probers such as western and least sandpiper and dunlin have relatively short bills and forage at or near the surface. Deep probers such as long-billed and short-billed dowitchers and greater yellowlegs have relatively long bills and probe deeper into the substrate. Shallow feeders such as black-necked stilt and American avocet feed by pecking or sweeping prey from the water column or surface.

Habitat suitability for shorebirds is dependent on water depth, percent of vegetation cover, and substrate. Tidal flats at low tide are the principal foraging area for most shorebirds in San Francisco Bay. Tidal flats and other tidal wetlands may be used by larger, longer-legged shorebirds as water levels rise, while smaller shorebirds have to move to foraging areas with exposed or shallower habitat. The presence of vegetation cover reduces the amount of suitable habitat for both probers and shallow feeders.

Species that forage on tidal flats include the black-bellied plover (*Pluvialis squatarola*), semipalmated plover (*Charadrius semipalmatus*), willet

(*Catoptrophorus semipalmatus*), long-billed curlew (*Numenius americanus*), marbled godwit (*Limosa fedoa*), red knot (*Calidris canutus*), dunlin, western sandpiper (*Calidris mauri*), least sandpiper (*Calidris minutilla*), short-billed dowitcher (*Limnodromus griseus*), and long-billed dowitcher (Hickey and W.D. Shuford 2003). Marsh channels, ponds, and wrack are used by many species of shorebirds for foraging. Vegetated portions of tidal wetland habitat are used to a lesser degree than tidal flats (Stralberg et al. 2003; Hickey and Shuford 2003). Vegetated portions of tidal wetland may be used for roosting and occasionally for nesting.

Table 6.3-6 identifies the shorebird species known to occur in Suisun Marsh, the season and land cover type in which these species typically occur, and habitat function provided by the land cover types.

Regulatory Setting

This section provides preliminary information on the major requirements for permitting, environmental review, and consultation related to wildlife resources for implementation of the SMP alternatives. Certain state and federal regulations require issuance of permits before implementation; other regulations require agency consultation but may not require issuance of any entitlements before implementation. The plan's requirements for permits and environmental review and consultation may change during the EIS/EIR review process as discussions with involved agencies proceed. Local regulatory requirements related to biological resources are described in Section 6.2, Vegetation and Wetlands.

Federal

The Endangered Species Act and the Fish and Wildlife Coordination Act are discussed in detail in Chapter 10, "Regulatory Framework." The Migratory Bird Treaty Act (MBTA) is discussed below.

Migratory Bird Treaty Act

The MBTA (16 USC 703) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It establishes seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703; 50 CFR 21; 50 CFR 10). Most actions that result in taking or in permanent or temporary possession of a protected species constitute violations of MBTA. USFWS is responsible for overseeing compliance with MBTA.

State

CEQA and CESA are discussed in detail in Chapter 10, "Regulatory Framework." Additional regulations pertinent to wildlife are discussed below.

California Fish and Game Code

Section 1600: Streambed Alteration Agreements

Under Sections 1600–1607 of the California Fish and Game Code, DFG has jurisdictional authority over wetland resources associated with rivers, streams, and lakes. DFG has the authority to regulate all work under the jurisdiction of the State of California that would substantially divert, obstruct, or change the natural flow of a river, stream, or lake; substantially change the bed, channel, or bank of a river, stream, or lake; or use material from a streambed.

DFG enters into a streambed alteration agreement with an applicant and can impose conditions on the agreement to ensure that no net loss of wetland values or acreage will be incurred. The streambed or lakebed alteration agreement is a discretionary permit subject to CEQA.

Sections 3503 and 3503.5: Protection of Bird Nests

California Fish and Game Code 3503 prohibits the killing of birds and the destruction of bird nests. California Fish and Game Code 3503.5 prohibits the killing of raptor species and the destruction of raptor nests and eggs. Many bird species potentially could nest in the study area or vicinity, and their nests would be protected under these sections of the California Fish and Game Code.

Multiple Sections: Fully Protected Species

The California Fish and Game Code provides protection from take for a variety of species, referred to as *fully protected species*. Section 5050 lists protected amphibians and reptiles. Section 5515 prohibits take of fully protected fish species. Section 3511 prohibits take of fully protected bird species. Fully protected mammals are protected under Section 4700. The California Fish and Game Code defines *take* as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." Migratory nongame birds are protected under Section 3800.

Environmental Consequences

Assessment Methods

Wildlife resources could be directly or indirectly affected by the SMP. The following types of actions could cause varying degrees of impacts on these resources:

- loss or degradation of habitat as a result of levee breaching or grading;

- loss or degradation of habitat as a result of increased scour;
- loss or conversion of managed wetlands or other land cover types as a result of tidal wetland restoration;
- loss of special-status species as a result of tidal wetland restoration;
- vegetation removal, grading, and other ground-disturbing activities;
- channel dewatering or installation of temporary water diversion structures;
- temporary stockpiling and sidecasting of soil, construction materials, or other construction wastes;
- dredging activities in wetlands and channels that contain ponded or flowing water and saturated soils; and
- disposal of dredged material on the waterside of levee banks or adjacent to the landside of levees.

Impact Analysis Assumptions

The SMP would result in temporary and permanent impacts on wildlife resources in the plan area. Temporary impacts would occur only during the construction or maintenance periods. Permanent impacts would be changes in land cover types. Potential changes to land cover types are described quantitatively in the Action Alternatives. Because of the nature of this plan analysis, other temporary and permanent impacts cannot be quantified, but they are discussed qualitatively.

This analysis assumes that tidal wetland restoration actions, specifically levee breaching, initially would result in the establishment of primarily tidal open water habitat, and also intertidal habitat areas for vegetation and special-status wildlife species. Some topography to support intertidal habitat will be established prior to breaching. Tidal wetland vegetation would establish as sediment accrues over time, reducing the amount of open water habitat and increasing tidal habitat. Impacts would occur to managed wetland habitats. Habitat values impacted would be offset, replaced and increased as tidal wetland vegetation becomes established. (See Figure 2-1.)

Impact Assessment Approach and Methods

This wildlife resources impact analysis is based on:

- the most current proposed implementation of the SMP, as developed by the Principal Agencies and summarized in the above assumptions; and
- existing biological resource information (sources are discussed under Affected Environment).

The mitigation measures for impacts on wildlife resources were developed through review of the plan description, prior environmental impact studies and reports for affected resources, discussions with resource agency personnel, and professional judgment.

Significance Criteria

The criteria for determining significant impacts on wildlife resources were developed by reviewing State CEQA Guidelines. Based on this information, the SMP likely would cause a significant impact if it would result in:

- a substantial temporary or permanent disruption of wildlife movement or fragmentation or isolation of habitats;
- a permanent loss of upland land cover types used by wildlife for breeding, roosting or foraging habitat;
- substantially reduce the habitat of a wildlife species;
- cause a wildlife population to drop below self-sustaining levels;
- reduce the number or restrict the range of an endangered, threatened or candidate wildlife species or species of special concern

Beneficial impacts are changes that would result in net increases in the extent or quality of habitat for special-status wildlife species. Substantial beneficial impacts are identified.

Environmental Impacts

No Action Alternative

Under the No Action Alternative, the SMP would not be implemented. As a result, the amount of restoration in the Marsh likely would be limited.

The No Action Alternative includes the following assumptions related to activities and associated impacts:

- It is assumed for purposes of this No Action Alternative evaluation that approximately 700 additional acres could be restored without the SMP.
- Managed wetland activities may become less frequent as a result of permitting difficulty. This could lead to difficulty in maintaining and operating managed wetlands, which could lead to reduced habitat values for species that use these areas.
- Impacts on habitat conditions such as water quality would continue to occur and could be exacerbated by the reduced implementation of maintenance activities that aid in flood and drain practices.

- Diversion restrictions on managed wetlands would continue to be enforced, and programs to encourage landowners to manage properties to protect certain habitat values would continue to be implemented.
- Programs to control managed wetland vegetation would continue.
- Any levee breaches that occur in inaccessible areas may not be fixed, and passive restoration could occur in these areas.

Overall, the No Action Alternative would result in habitat degradation as managed wetlands operations and maintenance are deferred, minimal tidal wetlands are created, and existing issues related to habitat functions such as water quality, food availability, and vegetative cover worsen. Absent the SMP, including both tidal restoration and managed wetland enhancement, all wildlife that uses the Marsh would be subject to increasingly degraded habitat conditions.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Implementation of Alternative A would result in the temporary or permanent loss or degradation of tidal wetlands, managed wetlands, and other land cover types in the study area. The impact on these land cover types and the associated mitigation measures are described in Section 6.2, Vegetation and Wetlands.

Tidal wetland restoration would occur by breaching and/or lowering exterior levees that currently protect managed wetlands from tidal inundation, resulting in the conversion of managed wetlands to tidal wetlands. The following actions related to tidal wetland restoration could affect special-status wildlife species, waterfowl, and other wildlife in the study area:

- the permanent and temporary loss of tidal wetlands, managed wetlands or other habitats because of construction-related activities;
- the permanent and temporary loss of habitat from the conversion of managed wetlands to tidal wetlands, including tidal inundation of vegetation communities previously protected by exterior levees;
- the change of waterfowl and shorebird nesting and conversion of overwintering habitat from the conversion of managed wetlands to tidal wetlands;
- the loss of tidal wetland habitat at breach locations as a result of increased scour;
- the loss or conversion of tidal wetlands from the potential impacts of upstream tidal muting; and
- the disturbance of breeding habitat for special-status species, waterfowl, and shorebirds by construction-related activities.

The following sections describe the impacts on special-status species and the associated mitigation measures.

Restoration Impacts

Impact WILD-1: Loss or Disturbance of Salt Marsh Harvest Mouse Suitable Habitat as a Result of Tidal Wetland Restoration

The salt marsh harvest mouse inhabits suitable vegetation communities in tidal and managed wetlands in the study area. Conversion of habitat in managed wetlands to tidal wetlands would result in a temporary reduction in salt marsh harvest mouse habitat. As the restored area evolves into a functioning, vegetated tidal wetland, it is expected to provide permanent suitable and sustainable habitat for the salt marsh harvest mouse. Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame that would have a potentially greater effect on this species. It is expected that suitable adjacent areas would continue to provide habitat for salt marsh harvest mouse between breaching the levee and the establishment of a fully functioning tidal wetland.

Restoration activities would include the construction of habitat levees that include benches or berms, which would provide opportunities for the establishment of high marsh/upland transition habitat. Habitat levees may be planted and seeded with native marsh species and/or allowed to colonize naturally with native and naturalized species. The habitat levees would provide habitat for the salt mouse harvest mouse as the remainder of the tidal wetland areas become established.

Environmental commitments in Chapter 2, Restoration Environmental Commitments, Mammals, address monitoring activities for salt marsh harvest mouse. Before and during restoration activities, a biologist will look for salt marsh harvest mouse and if it is found, construction activities will be stopped and continue once the individual has moved from the area. Pickleweed habitat may be removed during construction. Because temporary losses of suitable habitat would be offset by the restoration of tidal wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-2: Loss or Disturbance of California Clapper Rail Suitable Habitat as a Result of Tidal Wetland Restoration

California clapper rails inhabit suitable tidal wetlands and tidal sloughs in the study area. Restoration activities in these areas could disrupt clapper rail breeding habitat and foraging habitat in tidal wetlands. Clapper rails do not occupy managed seasonal wetlands; therefore, flooding of managed wetlands for the purpose of restoration would not affect clapper rails.

Breeding would not be disturbed during construction, and impacts on breeding habitat would be minimal, with implementation of the environmental commitments described in Chapter 2. Construction activity, including vegetation clearing, would be limited to months outside the breeding season, and staging areas would be sited at least 100 feet from water bodies. If construction activities are necessary during the breeding season, preconstruction surveys of suitable nesting habitat in and adjacent to the construction areas would be performed to identify the general location of clapper rail nest sites in the project area and nesting habitat areas will be flagged for avoidance, if construction activities would occur during the nesting season. Disturbance in these areas will be avoided until after the nesting season. Additionally, breach sites and other restoration features would be designed to avoid sensitive habitats to the extent possible.

There could be a minor, temporary loss of foraging habitat as a result of construction-related activities throughout the Marsh. Additionally, increased scour and tidal muting that could occur as a result of restoration could result in the temporary loss of California clapper rail foraging habitat. Regardless, restoration actions are not expected to adversely affect clapper rail because the minor and temporary loss of foraging habitat is not considered substantial given the amount of foraging habitat remaining and restored.

Conversion of managed wetlands to tidal wetlands would result in increased clapper rail breeding and foraging habitat. The plan includes design features that would promote the establishment of natural permanent clapper rail habitat, including habitat levees that provide tidal habitats. As the restored area evolves into a functioning, vegetated tidal wetland, it is expected to provide permanent, sustainable, suitable habitat for the clapper rail. Habitat levees also would provide refugia from high water events.

Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame that would have a potentially greater effect on this species. It is expected that suitable adjacent areas would continue to provide habitat for clapper between breaching the levee and the establishment of a fully functioning tidal wetland.

Because breeding season impacts will be avoided and temporary losses of suitable habitat would be offset by the restoration of tidal wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-3: Loss or Disturbance of California Black Rail Suitable Habitat as a Result of Tidal Wetland Restoration

California black rails inhabit suitable tidal wetlands and managed wetlands in the study area. The types of impacts described for clapper rail above also apply to the black rail, although the black rail is more common and more widely distributed throughout the Marsh than the clapper rail. The same environmental commitments (Chapter 2), including avoiding construction during breeding season or a preconstruction survey, would apply, thus avoiding disturbance during breeding season.

Construction-related activities, the inundation of suitable habitat in managed wetlands, and the impacts of increased scour and tidal muting could result in the temporary loss of black rail breeding and foraging habitat. As described above for the clapper rail, the overall 30-year plan is expected to benefit black rail by encouraging development of a more natural habitat through restoration of managed wetlands to tidal wetlands.

Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame that would have a potentially greater effect on this species. It is expected that suitable adjacent areas would continue to provide habitat for black rail use between breaching the levee and the establishment of a fully functioning tidal wetland.

Because breeding season impacts will be avoided and temporary losses of suitable habitat would be offset by the restoration of tidal wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-4: Loss or Disturbance of Suisun Shrew Suitable Habitat as a Result of Tidal Wetland Restoration

Suisun shrews inhabit suitable vegetation communities in tidal and managed wetlands in the study area. Construction-related activities, the inundation of suitable habitat in managed marshes, and the impacts of increased scour and tidal muting could result in the temporary loss of Suisun shrew breeding and foraging habitats. As the restored area evolves into a functioning, vegetated tidal wetland, it is expected to provide permanent suitable and sustainable habitat for the Suisun shrew. Additionally, breach sites and other restoration features would be designed to avoid sensitive habitats to the extent possible.

Conversion of suitable habitat in managed wetlands to tidal wetlands would result in a temporary reduction in suitable habitat. The plan includes design features that would promote the establishment of natural permanent Suisun shrew habitat, including habitat levees that provide tidal wetland and transitional zone habitat. As the restored area evolves into a functioning tidal wetland, it is expected to provide permanent suitable habitat for the shrew.

Restoration activities would include the construction of habitat levees that include benches or berms, which would provide opportunities for the establishment of high marsh/upland transition habitat. Habitat levees may be planted and seeded with native marsh species and/or allowed to colonize naturally with native and naturalized species. The habitat levees would provide habitat for the Suisun shrew as the remainder of the tidal wetland areas become established.

Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame that would have a potentially greater effect on this species. It is expected that suitable adjacent areas would continue to provide habitat for Suisun shrew between breaching the levee and the establishment of a fully functioning tidal wetland.

Because temporary losses of suitable habitat would be offset by the restoration of tidal wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-5: Loss or Disturbance of California Least Tern Suitable Habitat as a Result of Tidal Wetland Restoration

California least terns are known to breed at one location on the east side of Suisun Marsh and to forage in the bays, sloughs, tidal wetlands and managed wetlands in the Marsh. Preconstruction surveys would be performed to identify least tern nest sites, and construction-related activities during the breeding season in the vicinity of active nests would be avoided as described in the Environmental Commitments section in Chapter 2. Construction activities would not significantly affect foraging habitat because open water habitat is abundant in the study area.

Conversion of suitable foraging habitat in managed wetlands to tidal wetlands would result in an increase in suitable foraging habitat because the tidal wetland restoration areas would be subject to tidal action and therefore would be inundated permanently or more frequently than the managed wetlands. As the restored area evolves into a functioning tidal wetland, it will continue to provide suitable habitat for the least tern.

Because breeding season impacts will be avoided and temporary losses of suitable habitat would be offset by the restoration of tidal wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-6: Loss of Suisun Song Sparrow and Salt Marsh Common Yellowthroat Suitable Habitat as a Result of Tidal Wetland Restoration

Suisun song sparrows and salt marsh common yellowthroats are known to breed in suitable habitat in tidal and managed wetlands throughout the Marsh. Restoration activities in these areas could disrupt breeding habitat and foraging habitat in tidal wetlands.

Breeding would not be disturbed during construction, and impacts on breeding habitat would be minimal with implementation of the environmental commitments described in Chapter 2. Preconstruction surveys would be performed to identify nest sites in the project area, and construction activity in the vicinity of active nests would be limited to months outside the breeding season. Any sensitive resources, such as nests, would be flagged and avoided. Breach sites and other restoration features would be designed to avoid sensitive habitats to the extent possible.

The plan includes design features that would promote the establishment of natural permanent breeding and foraging habitat, including habitat levees that provide tidal wetland and transitional zone habitat. As the restored area evolves into a functioning tidal wetland, it is expected to provide permanent suitable habitat for these species.

Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame that would have a potentially greater effect on this species. It is expected that suitable adjacent areas would continue to provide habitat for Suisun song sparrow and salt marsh common yellowthroat between breaching the levee and the establishment of a fully functioning tidal wetland.

Because breeding season impacts will be avoided and temporary losses of suitable habitat would be offset by the restoration of tidal wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-7: Loss or Disturbance of Raptor Nest Sites or Foraging Habitat as a Result of Tidal Wetland Restoration

Raptors, including northern harrier, short-eared owl, white-tailed kite, Swainson’s hawk, and western burrowing owl, are known to breed in suitable habitats in the study area. Western burrowing owl occurs in upland habitats associated with grassland, therefore this species is not expected to occur in potential construction areas and would not be affected by the plan. Swainson’s hawk requires mature trees for nesting. Although potential nest trees are available, the study area is on the edge of the species’ range and foraging habitat is limited to grasslands in the northern and eastern borders of the study area. Therefore Swainson’s hawk is not expected to be affected by the plan.

White-tailed kites require trees and shrubs for nesting and grassland and open habitats for foraging. Northern harrier and short-eared owl are ground nesters.

Breeding would not be disturbed during construction and impacts on breeding habitat would be minimal with implementation of the environmental commitments described in Chapter 2. Environmental commitments include preconstruction surveys performed to identify nest sites in the project area, and construction activity in the vicinity of active nests would be limited to months outside the breeding season. All woody and herbaceous vegetation would be removed from the construction areas during the nonbreeding season (September 1–February 1) to minimize effects on nesting birds. Any sensitive resources, such as nests, would be flagged and avoided.

A temporary reduction in foraging habitat could occur for those species that forage in managed wetlands. Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame that would have a potentially greater effect on this species. It is expected that suitable adjacent areas would continue to provide habitat for raptors between breaching the levee and the establishment of a fully functioning tidal wetland.

Because breeding season impacts will be avoided and temporary losses of suitable habitat would be offset by the restoration of tidal wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-8: Loss or Disturbance of Western Pond Turtle as a Result of Tidal Wetland Restoration

Western pond turtles occur in the upper reaches of tidal sloughs, managed wetlands, brackish habitats, permanently flooded water supply ditches, and other areas throughout the study area where there is permanent or nearly permanent water. The conversion of suitable habitat in managed wetlands to tidal wetlands would result in the permanent or temporary loss of breeding habitat for western pond turtles.

Preconstruction surveys will be performed in all managed wetlands and in adjacent sloughs that provide suitable habitat. If pond turtles are identified, the area will be surveyed for nesting sites, if construction activities would occur during the nesting season. Breaching of levees in occupied breeding habitat would occur outside of the breeding months of April to July. If pond turtles are identified in managed wetlands to be breached, the ponds and associated drainages will be dewatered and, to the extent feasible, any turtles observed will be captured and released to other suitable locations within a nearby managed wetland or drainage. Breach sites and other restoration features would be designed to avoid sensitive habitats to the extent possible.

Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame that would have a potentially greater effect on this species. It is expected that suitable adjacent areas and some restored wetlands would provide habitat for pond turtles.

Because most impacts on pond turtles will be avoided and permanent or temporary loss of suitable habitat would be offset by the restoration of tidal wetlands and enhancement of managed wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-9: Loss or Disturbance of Tricolored Blackbird as a Result of Tidal Wetland Restoration

Tricolored blackbirds may breed in emergent wetland vegetation associated with tidal and managed wetlands. Conversion of suitable habitat in managed wetlands to tidal wetlands may result in a permanent or temporary reduction in suitable habitat.

Breeding would not be disturbed during construction, and impacts on breeding habitat would be minimal with implementation of the environmental commitments described in Chapter 2. Preconstruction surveys would be performed to identify nest sites in the project area, and construction activity in the vicinity of active nests would be limited to months outside the breeding season. Any sensitive resources, such as nesting colonies, would be flagged and avoided. Breach sites and other restoration features would be designed to avoid sensitive habitats to the extent possible.

Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame that would have a potentially greater effect on this species. It is expected that suitable adjacent areas would continue to provide habitat for tricolored blackbirds.

Because impacts on tricolored blackbirds will be minimized and any loss of suitable habitat would be compensated for by the enhancement of managed wetlands, this impact is considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WILD-10: Effects on Southern Resident Killer Whales as a Result of Changes in Salmon Populations

Tidal wetland restoration has the potential to affect the prey base (Chinook salmon) of southern resident killer whales. Restoration could have an effect on salmonid populations (see Section 6.1, Fish), which would indirectly affect southern resident killer whales. If Chinook salmon populations were negatively affected, a reduction in prey availability for the southern resident killer whales could occur. Reductions in prey availability may force the whales to travel longer distances to find prey or select lesser-quality prey, resulting in reduced reproductive rates and higher mortality.

Tidal wetland restoration is expected to increase rearing habitat for juvenile Chinook salmon in Suisun Marsh. Tidal wetlands are more productive and would allow better growth and survival of Chinook salmon. The portion of the killer whale prey base that comes from Suisun Marsh is small compared to Pacific Northwest and Central Valley streams. Salmon distribution and population also are affected by many factors, which include ocean conditions and pollution.

Conclusion: No impact. No mitigation required.

Impact WILD-11: Loss or Disturbance of Waterfowl or Shorebird Habitat as a Result of Tidal Wetland Restoration

Managed wetlands provide nesting, foraging, and wintering habitat for waterfowl and shorebirds. Tables 6.3-5 and 6.3-6 identify how various guilds and species use habitat in the Marsh.

Breeding would not be disturbed during construction, and impacts on breeding would be minimal with implementation of the environmental commitments described in Chapter 2. Preconstruction surveys would be performed to identify nest sites in the project area, and construction activity in the vicinity of active nests would be limited to months outside the breeding season. Any sensitive resources, such as nests, would be flagged and avoided. These actions would minimize effects on actively nesting waterfowl or shorebirds during the construction period. Additionally, prior to breaching the levee, specific project proponents would manage vegetation and other resources to promote growth of tidal wetland plant species.

Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame. It is expected that suitable adjacent areas would continue to provide habitat and enhancement activities would offset this loss by improving remaining managed wetlands and therefore improving habitats that support waterfowl and shorebirds. Most of the diving ducks in the Marsh will benefit during the tidal marsh establishment period, and will continue to use deeper areas of wetlands and channels as the tidal wetlands become established. Additionally, as tidal wetlands are established, shorebirds are expected to benefit as a result of more natural habitat developed through restoration activities.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities Impacts

Impact WILD-12: Loss or Disturbance of Salt Marsh Harvest Mouse Suitable Habitat as a Result of Managed Wetland Activities

The salt marsh harvest mouse inhabits suitable vegetation communities in tidal and managed wetlands in the study area. Some of the proposed management activities would occur in managed wetlands and have the potential to temporarily disrupt suitable habitat areas. The activities that would occur in the managed wetlands have the potential to increase in magnitude under the Proposed Project. This change in magnitude is not expected to result in a substantial change in disturbance to salt marsh harvest mouse habitat because most of the managed wetlands would continue to provide habitat. Restoration actions would contribute to recovery of the salt marsh harvest mouse over the 30-year implementation period.

Managed wetland activities would be implemented on individual parcels throughout the 30-year implementation period and would improve flood and drain capabilities and levee stability in the Marsh. The improvement of flood and drain capabilities could result in the creation or enhancement of suitable habitat in the managed wetlands. Providing levee stability would minimize the potential for catastrophic loss of salt marsh harvest mouse habitat in managed wetlands. Levee stability activities have been occurring for decades, and the SMP would increase their frequency thereby reducing the frequency of impacts due to levee breaches..

Conclusion: Less than significant. No mitigation required.

Impact WILD-13: Loss or Disturbance of California Clapper Rail Suitable Habitat as a Result of Managed Wetland Activities

California clapper rails inhabit suitable tidal wetlands and tidal sloughs in the study area. Managed wetland activities in these areas could disrupt clapper rail habitat. Specifically, levee maintenance activities for managed wetland levees, that would affect tidal wetland vegetation have the potential to temporarily reduce or disturb clapper rail habitat in tidal wetlands.

Authorized work will not be conducted in the areas shown on the California clapper rail breeding habitat maps between February 1 and August 31 (Figure 2-6). Breeding would not be disturbed during maintenance activities, and impacts on breeding habitat would be minimal with implementation of the other environmental commitments described in Chapter 2.

Many of the managed wetland activities that have the potential to affect California clapper rail habitat in tidal wetlands are currently being implemented but would occur more frequently under the Proposed Project. This change in magnitude is not expected to result in a substantial change in foraging habitat, nests would continue to be avoided, and maintenance activities would not occur during the breeding season. New activities such as dredging and placement of new riprap in tidal and nontidal areas have the potential to remove a minor amount of vegetation. Similar to other managed wetland activities, restrictions related to breeding season and nest sites would be in place. California clapper rail do not use managed wetlands. Therefore, marsh management activities that occur or affect the managed wetlands would not affect this species.

Additionally, as described in Chapter 2, these maintenance activities would be designed to avoid and minimize effects on tidal wetland vegetation. All managed wetland activities would occur over the 30-year implementation period and throughout the Marsh, avoid nests and breeding season in applicable areas, and not substantially change the foraging habitat available to the rail at any one time. Additionally, restoration actions would contribute to recovery of the clapper rail over the 30-year implementation period.

Conclusion: Less than significant. No mitigation required.

Impact WILD-14: Loss or Disturbance of California Black Rail Suitable Habitat as a Result of Managed Wetland Activities

California black rails inhabit suitable tidal wetlands and managed wetlands in the study area. The types of impacts described for clapper rail above also apply to the black rail, although the black rail does occur in managed wetlands and is more common and more widely distributed throughout the Marsh than the clapper rail. Managed wetland activities that remove vegetation have the potential to temporarily reduce foraging habitat.

Breeding would not be disturbed during construction, and impacts on breeding habitat would be minimal with implementation of the environmental commitments described in Chapter 2. Maintenance activities would be limited to months outside the breeding season. As described above for the clapper rail, the small change in magnitude of currently implemented activities and the new activities are not expected to result in substantial changes in suitable foraging habitat or breeding. Additionally, restoration actions would contribute to recovery of the black rail over the 30-year implementation period.

Conclusion: Less than significant. No mitigation required.

Impact WILD-15: Loss or Disturbance of Suisun Shrew Suitable Habitat as a Result of Managed Wetland Activities

Suisun shrews inhabit suitable vegetation communities in tidal and managed wetlands in the study area. Managed wetland activities in managed wetlands would result in a temporary reduction in suitable habitat.

The change in magnitude of the currently implemented activities is not expected to result in a substantial increase in shrew habitat disturbance, and new activities would occur primarily on the waterside of managed wetlands. Placement of new riprap in tidal areas, constructing new interior levees, and constructing cofferdams have the potential to remove shrew habitat, but the amount is considered minimal given the extent of managed wetland areas that would continue to provide suitable habitat. Suisun shrew do not use managed wetlands. Therefore, marsh management activities that occur or affect the managed wetlands would not affect this species.

Conclusion: Less than significant. No mitigation required.

Impact WILD-16: Loss or Disturbance of California Least Tern Suitable Habitat as a Result of Managed Wetland Activities

California least terns are known to breed at one location on the east side of Suisun Marsh and to forage in the bays, sloughs, and managed wetlands in the Marsh. New activities such as dredging, new riprap placement, brushboxes, and construction of new interior levees and cofferdams have the potential to disrupt nest sites, but no SMP work will occur in the vicinity of that occupied habitat.

Maintenance activities would not significantly affect foraging habitat because open water habitat is abundant in the study area.

Currently implemented activities also have the potential to affect breeding habitat. However, the change in magnitude of the currently implemented managed wetland activities would not result in a substantial temporary or permanent change in foraging habitat. Additionally, restoration actions would contribute to recovery of the least tern over the 30-year implementation period.

Marsh management activities, specifically providing levee stability, also would contribute to maintaining California least tern foraging habitat habitat in managed wetlands. These activities would be implemented on individual parcels throughout the 30-year implementation period and would improve flood and drain capabilities and levee stability in the Marsh. Providing levee stability would minimize the potential for catastrophic loss of California least tern foraging habitat in managed wetlands because managed marsh water levels would not be affected by levee breaches.

Conclusion: Less than significant. No mitigation required.

Impact WILD-17: Loss or Disturbance of Suisun Song Sparrow and Salt Marsh Common Yellowthroat Suitable Habitat as a Result of Managed Wetland Activities

Suisun song sparrow and salt marsh common yellowthroat breed in tidal and managed wetlands throughout the Marsh. Managed wetland activities in the vicinity of active nests would be avoided during breeding season.

Currently implemented activities also have the potential to affect breeding habitat. However, the change in magnitude of the currently implemented managed wetland activities would not result in a substantial temporary or permanent change in foraging habitat. Additionally, restoration actions would contribute to recovery of the Suisun song sparrow and salt marsh common yellowthroat over the 30-year implementation period.

Marsh management activities also would contribute to maintaining Suisun song sparrow and salt marsh yellowthroat habitat. These activities would be implemented on individual parcels throughout the 30-year implementation period and would improve flood and drain capabilities and levee stability in the Marsh. The improvement of flood and drain capabilities could result in the creation or enhancement of suitable habitat in the managed wetlands by improving water quality and promoting the establishment of suitable breeding habitat. Providing levee stability would minimize the potential for catastrophic loss of habitat in managed wetlands.

Conclusion: Less than significant. No mitigation required.

Impact WILD-18: Loss or Disturbance of Raptor Nest Sites or Foraging Habitat as a Result of Managed Wetland Activities

Raptors, including northern harrier, short-eared owl, white-tailed kite, Swainson's hawk, and western burrowing owl, are known to breed in suitable habitats in the study area. These species generally forage in areas near nest sites. Managed wetland activities in the vicinity of active nests would not be implemented during breeding season.

Breeding would not be disturbed during maintenance activities, and impacts on breeding habitat would be minimal with implementation of the environmental commitments described in Chapter 2. A temporary reduction in foraging habitat could occur for those species that forage in managed wetlands.

Currently implemented activities also have the potential to affect breeding habitat. However, the change in magnitude of the currently implemented managed wetland activities would not result in a substantial temporary or permanent change in foraging habitat. Additionally, many of these species breed and forage in upland areas that are less likely to be affected by managed wetland activities in managed wetlands and tidal sloughs.

Conclusion: Less than significant. No mitigation required.

Impact WILD-19: Loss or Disturbance of Western Pond Turtle as a Result of Managed Wetland Activities

Western pond turtles occur in the upper reaches of tidal sloughs, managed wetlands, brackish habitats, permanently flooded water supply ditches, and other areas throughout the study area where there is permanent or nearly permanent water. Currently implemented activities have the potential to affect breeding and foraging habitat. However, the change in magnitude of the currently implemented managed wetland activities would not result in a substantial temporary or permanent change in habitat, and activities are conducted when the managed wetlands are dry.

Marsh management activities also would contribute to maintaining western pond turtle habitat. These activities would be implemented on individual parcels throughout the 30-year implementation period and would improve flood and drain capabilities and levee stability in the Marsh. The improvement of flood and drain capabilities could result in the creation or enhancement of suitable habitat in the managed wetlands. Improved water quality (i.e., water that is less saline) will also benefit western pond turtles. Providing levee stability would minimize the potential for catastrophic loss of western pond turtle habitat in managed wetlands.

Conclusion: Less than significant. No mitigation required.

Impact WILD-20: Loss or Disturbance of Tricolored Blackbird as a Result of Managed Wetland Activities

Tricolored blackbirds may breed in emergent wetland vegetation associated with tidal and managed wetlands. Breeding would not be disturbed during construction, and impacts on breeding habitat would be minimal with implementation of the environmental commitments described in Chapter 2.

Currently implemented activities also have the potential to affect breeding habitat. However, the change in magnitude of the currently implemented managed wetland activities would not result in a substantial temporary or permanent change in foraging habitat. Enhancement of managed wetlands could result in an increase in suitable habitat for tricolored blackbirds.

Marsh management activities also would contribute to maintaining tricolored blackbird habitat. These activities would be implemented on individual parcels throughout the 30-year implementation period and would improve flood and drain capabilities and levee stability in the Marsh. The improvement of flood and drain capabilities could result in the creation or enhancement of suitable habitat in the managed wetlands. Providing levee stability would minimize the potential for catastrophic loss of breeding habitat in managed wetlands.

Conclusion: Less than significant. No mitigation required.

Impact WILD-21: Effects on Southern Resident Killer Whales as a Result of Changes in Salmon Populations Result of Managed Wetland Activities

Managed wetland activities have the potential to affect the prey base (Chinook salmon) of southern resident killer whales. If Chinook salmon populations were substantially negatively affected, a reduction in prey availability for the southern resident killer whales could occur. Reductions in prey availability may force the whales to travel longer distances to find prey or select lesser quality prey, resulting in reduced reproductive rates and higher mortality.

Some managed wetland activities could benefit Chinook salmon through water quality improvements achieved by improving flood and drain capabilities and installation of fish screens. However, activities in tidal sloughs such as dredging and riprap placement could reduce or alter Chinook salmon habitats. The portion of the killer whale prey base that comes from Suisun Marsh is small compared to Pacific Northwest and Central Valley streams. Salmon distribution and population are also affected by many factors that include ocean conditions and pollution. It is not expected that change in magnitude of currently implemented activities or the addition of new activities would affect salmon populations to the extent that a substantial change in prey base for killer whales would occur. Additionally, restoration actions would contribute to recovery of the Chinook salmon over the 30-year implementation period.

Conclusion: Less than significant. No mitigation required.

Impact WILD-22: Changes in Waterfowl Nesting and Wintering Habitat as a Result of Marsh Management Activities

Managed wetlands provide nesting and overwintering habitat for resident and migratory waterfowl. These wetlands are managed primarily for ducks and other hunted waterfowl. Marsh management activities generally are implemented in the late summer when waterfowl are not present. Activities are intended to improve habitat for these species by managing flood and drain cycles that support the desired assortment of vegetation communities and protecting managed wetland from catastrophic flood events. These activities are expected to improve the overall habitat values within the managed wetlands. As such, it is expected that the increase in magnitude of the currently implemented activities and the new activities would result in a net benefit to waterfowl.

Conclusion: Beneficial.

Impact WILD-23: Changes in Shorebird Nesting and Wintering Habitat as a Result of Marsh Management Activities

Managed wetlands provide nesting and overwintering habitat for resident and migratory shorebirds. These wetlands are managed primarily for ducks and other hunted waterfowl, but also benefit shorebirds. Marsh management activities generally are implemented in the late summer when shorebirds are not nesting or wintering. Although these activities are designed specifically to benefit ducks and other waterfowl, they are expected also to benefit shorebirds by improving habitats and reducing the likelihood of catastrophic flood events that could reduce available suitable habitats. As such, it is expected that the increase in magnitude of the currently implemented activities and the new activities would result in a net benefit to shorebirds.

Conclusion: Beneficial.

Alternative B: Restore 2,000–4,000 Acres

The types of impacts and their level of significance that would occur under Alternative B are the same as described for Alternative A. Under Alternative B, there would be less tidal restoration and more managed wetland activities than under Alternative A; therefore, impacts related to restoration would occur less frequently and impacts related to managed wetland activities would occur more frequently. In general, bird (except waterfowl), raptor, and mammal species that use managed wetlands would be exposed to a similar level of temporary changes in suitable habitat while restoration and managed wetland activities are implemented. However, the temporary magnitude of effect on suitable habitat for these species is expected to be less because less land type conversion (restoration) would occur. Long-term benefits to these species would be less because managed wetlands may not be able to provide optimum habitat that is expected to be provided by restoring parcels to tidally inundated habitats.

Alternative C: Restore 7,000–9,000 Acres

The types of impacts and their level of significance that would occur under Alternative C are the same as described for Alternative A. Under Alternative C, there would be more tidal restoration and less managed wetland subject to managed wetland activities than under Alternative A; therefore, impacts related to restoration would occur more frequently and impacts related to managed wetland activities would occur less frequently. In general, bird (except waterfowl), raptor, and mammal species that use managed wetlands would be exposed to a similar level of temporary changes in suitable habitat while restoration and managed wetland activities are implemented. However, the temporary magnitude of effect on suitable habitat for these species is expected to be greater because more land type conversion (restoration) would occur. However, long-term benefits to these species would be greater because managed wetlands may not be able to provide optimum habitat that is expected to be provided by restoring parcels to tidally inundated habitats.