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.

6.1 Fish

Introduction

This assessment covers species within aquatic environments potentially affected by the SDIP, including the Sacramento, American, Feather, San Joaquin, and Trinity Rivers, the Delta, and Suisun Bay. Although many fish species occur within the affected aquatic environment, the assessment focuses on Central Valley fall-/late fall–run Chinook salmon (ESA, candidate), Sacramento River winter-run Chinook salmon (ESA and CESA, endangered), Central Valley spring-run Chinook salmon (ESA and CESA, threatened), Southern Oregon/northern California coasts coho salmon (ESA and CESA, threatened), Central Valley steelhead (ESA, threatened), delta smelt (ESA and CESA, threatened), splittail (ESA, listing withdrawn), striped bass (an important sport fish), and green sturgeon (ESA, proposed threatened). The response of the selected 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.

This section includes the following information:

- a summary of significant impacts that could result from implementation of the SDIP alternatives;
- a description of the affected environment, including the life histories and existing environmental conditions for factors that may affect the abundance and survival of the selected species;
- a description of the assessment methods that were used to evaluate potential impacts of the SDIP alternatives; and
- a description of the effects (i.e., environmental consequences) for each SDIP alternative on fish and fish habitat, including identification of significant impacts and measures to mitigate significant impacts.

Summary of Significant Impacts

Implementation of the SDIP alternatives includes construction and operation of gates in the south Delta, dredging, and water supply operations that affect fish and fish habitat in the Delta and rivers upstream of the Delta. Construction of the gates results in less-than-significant impacts because environmental commitments (Chapter 2, “Project Description”) and BMPs will be implemented and the area disturbed by construction of gates would be similar to the existing footprint of the temporary barriers. Operation of the permanent gates would have less-than-significant impacts given that effects on net and tidal flow would be similar to conditions with the existing temporary barriers, and operability would increase flexibility to minimize existing effects. Dredging would increase channel depth, but habitat area and quality would be similar to pre-dredged conditions, and a dredge monitoring program will be implemented to confirm minimal effects of dredging on fish habitat (Chapter 2, "Project Description").

Water supply operations would have only slight effects on spawning habitat area, rearing habitat area, migration habitat conditions, water temperature, and food availability in the rivers upstream of the Delta and in the Delta and Suisun Bay. These upstream impacts are determined to be less than significant. The changes in SWP and CVP monthly pumping for Alternative 2B are relatively small, and entrainment-related losses would have a less-than-significant impact on any fish population. Significant impacts occur because of increased SWP pumping under Alternatives 2A and 2C. Increased SWP pumping during March through June increases entrainment-related losses of San Joaquin fall-run Chinook salmon, spring-run Chinook salmon, winter-run Chinook salmon, steelhead, delta smelt, and striped bass. Impacts and mitigation measures are identified by species and time of impact. Therefore, Mitigation Measures Fish-MM-1, Fish-MM-2, and Fish-MM-3 would together mitigate all significant impacts on fish to a less than significant level during the specified months. The combined effects of these mitigation measures can be summarized with the following avoidance and crediting system for entrainment impacts that could occur between November 1 and June 30 (if an expanded EWA is not implemented by CALFED):

1. ***Avoidance Measure.*** All pumping at SWP Banks that is in excess of the existing permitted capacity from November 1 through June 30 will be tracked by EWA and SWP/CVP operations staff. When EWA actions reduce exports for fish protection during this period, any pumping at SWP Banks that is above the existing permitted capacity will be reduced without cost to the EWA account, limited only by the amount of pumping reduction funded by the EWA (i.e., maximum of 100% match with EWA action).
2. ***Crediting Measure.*** From November 1 through March 31, pumping-reduction credits will be given to the EWA (ranging from 10% to up to 30%) for all non-EWA pumping that is above the existing permitted capacity. Under this mitigation component, for each 100 taf of non-EWA pumping above the existing permitted capacity, a pumping reduction credit, ranging from 10 taf to 30 taf, could be used by EWA to reduce pumping during periods of high fish density.

This relatively simple avoidance of impacts during periods of EWA actions, in addition to an EWA credit for mitigation of periods with remaining pumping above the existing permitted capacity, will reduce the entrainment impacts to a less than significant level. DWR and Reclamation will coordinate with DFG, NOAA Fisheries, and USFWS to determine the appropriate credit percentage. When an expanded EWA (i.e., greater than CALFED ROD EWA) is implemented by CALFED, as assumed in the 2004 OCAP documents, this SDIP avoidance and crediting system (composed of Fish-MM-1, Fish-MM-2, and Fish-MM-3) would no longer be required because the expanded EWA is assumed to be sufficient to mitigate any entrainment impacts from the incremental pumping above the existing permitted capacity. In addition, as part of DWR and Reclamation ongoing environmental assurances, the CALFED Conveyance Program initiative to investigate and improve CVP and SWP fish salvage, handling, and release facilities and procedures will be supported for a 5-year period. Short-term changes in procedures and facilities that are recommended by the South Delta Fish Facilities Forum may be funded by DWR and Reclamation as part of this commitment. If these facility upgrades or procedural changes are determined to be equivalent to the avoidance and crediting system described above, these salvage facility and procedural changes may be substituted for the pumping restrictions as alternative cost-effective mitigation.

Table 6.1-S presents a summary of the significant impacts on fish and associated mitigation measures for each project alternative. The mitigation measure will provide effective protection for each of these identified impacts and reduce the aggregate impacts to less than significant.

Table 6.1-S. Summary of Significant Fish Impacts and Mitigation Measures

Operations Related Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
Fish-46: Operations-Related Increases in Entrainment-Related Losses of Fall-/Late Fall–Run Chinook Salmon from the San Joaquin River Basin.	2A, 2C	Significant	Fish-MM-1: Minimize Entrainment-Related Losses of Juvenile Fall-/Late Fall–Run Chinook Salmon from the San Joaquin River Basin That May Be Caused by Increased SWP Pumping from May 16 through May 31.	Less than Significant
Fish-47: Operations-Related Increases in Entrainment-Related Losses of Chinook Salmon from the Sacramento River Basin.	2A, 2C	Significant	Fish-MM-2: Minimize Entrainment-Related Losses of Juvenile Winter- and Spring-Run Chinook Salmon That May Be Caused by Increased SWP Pumping from March 1 through April 14 and May 16 through May 31.	Less than Significant
Fish-58: Operations-Related Increases in Entrainment Losses of Steelhead.	2A, 2C	Significant	Fish-MM-1: Minimize Entrainment-Related Losses of Juvenile Fall-/Late Fall–Run Chinook Salmon from the San Joaquin River Basin That May Be Caused by Increased SWP Pumping from May 16 through May 31. Fish-MM-2: Minimize Entrainment-Related Losses of Juvenile Winter- and Spring-Run Chinook Salmon That May Be Caused by Increased SWP Pumping from March 1 through April 14 and May 16 through May 31.	Less than Significant

Operations Related Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
Fish-63: Operations-Related Increases in SWP Pumping and Resulting Entrainment Losses of Delta Smelt.	2A, 2C	Significant	Fish-MM-3: Minimize Entrainment Losses of Delta Smelt Associated with Increased SWP Pumping.	Less than Significant
Fish-64: Operations-Related Reduction in Food Availability for Delta Smelt.	2A, 2C	Significant	Fish-MM-3: Minimize Entrainment Losses of Delta Smelt Associated with Increased SWP Pumping.	Less than significant
Fish-73: Operations-Related Increases in SWP Pumping and Resulting Entrainment Losses of Striped Bass.	2A, 2C	Significant	Fish-MM-1: Minimize Entrainment-Related Losses of Juvenile Fall-/Late Fall–Run Chinook Salmon from the San Joaquin River Basin That May Be Caused by Increased SWP Pumping from May 16 through May 31.	Less than Significant
			Fish-MM-2: Minimize Entrainment-Related Losses of Juvenile Winter- and Spring-Run Chinook Salmon That May Be Caused by Increased SWP Pumping from March 1 through April 14 and May 16 through May 31.	
			Fish-MM-3: Minimize Entrainment Losses of Delta Smelt Associated with Increased SWP Pumping.	
Fish-74: Operations-Related Reduction in Food Availability for Striped Bass.	2A, 2C	Significant	Fish-MM-3: Minimize Entrainment Losses of Delta Smelt Associated with Increased SWP Pumping.	Less than significant

Affected Environment

This section describes the life history, habitat requirements, and factors that affect the abundance of species selected for the assessment of impacts of the SDIP. 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, splittail, and green sturgeon are native species that occur in streams of the Central Valley and the Delta. Striped bass is an abundant nonnative fish that occurs in the Central Valley and the Delta. Southern

Oregon/northern California coasts coho salmon occurs in the Trinity River. The coho salmon is included in the impact analysis because operation of the SWP and CVP in response to changes in Delta operations has the potential to affect Trinity River flows. Although a court ruling has upheld the Trinity River ROD, which mandated restoration flows to be released from the Trinity River, thereby isolating the Trinity River from operations in the Central Valley and reducing potential SDIP effects, an assessment of the Trinity River potential SDIP effects is presented. Table 6.1-1 lists some of the native and nonnative fishes that occur in the Central Valley system.

Table 6.1-1. Central Valley Species Potentially Affected by the Proposed Alternatives

Common Name—Origin	Scientific Name	Distribution
Lamprey (2 species)—native	*Lampetra* spp.	Central Valley rivers; Delta; San Francisco Bay estuary
Chinook salmon (winter-, spring-, fall-, and late fall–runs)—native	*Oncorhynchus tshawytscha*	Central Valley rivers; Delta; San Francisco Bay estuary
Chum salmon—rare	*Oncorhynchus keta*	Central Valley rivers; Delta and San Francisco Bay estuary
Kokanee—nonnative	*Oncorhynchus nerka*	Central Valley reservoirs
Steelhead/rainbow trout—native	*Oncorhynchus mykiss*	Central Valley rivers; Delta and San Francisco Bay estuary
Brown trout—nonnative	*Salmo trutta*	Central Valley reservoirs
White sturgeon—native	*Acipenser transmontanus*	Central Valley rivers; Delta; San Francisco Bay estuary
Green sturgeon—native	*Acipenser medirostris*	Central Valley rivers; Delta; San Francisco Bay estuary
Longfin smelt—native	*Spirinchus thaleichthys*	Delta and San Francisco Bay estuary
Delta smelt—native	*Hypomesus transpacificus*	Delta and San Francisco Bay estuary
Wakasagi—nonnative	*Hypomesus nipponensis*	Central Valley rivers and reservoirs; Delta
Sacramento sucker—native	*Catostomus occidentalis*	Central Valley rivers; Delta
Sacramento pikeminnow—native	*Ptychocheilus grandis*	Central Valley rivers; Delta
Splittail—native	*Pogonichthys macrolepidotus*	Central Valley rivers; Delta and San Francisco Bay estuary
Sacramento blackfish	*Orthodon microlepidotus*	Central Valley rivers; Delta
Hardhead—native	*Mylopharodon conocephalus*	Central Valley rivers; Delta
Speckled dace—native	*Rhinichthys osculus*	Sacramento River and tributaries
California roach—native	*Lavinia symmetricus*	Central Valley Rivers
Hitch—native	*Lavina exilicauda*	Central Valley rivers; Delta
Golden shiner—nonnative	*Notemigonus crysoleucas*	Central Valley rivers and reservoirs; Delta
Fathead minnow—nonnatve	*Pimephales promelas*	Central Valley rivers and reservoirs; Delta

Common Name—Origin	Scientific Name	Distribution
Goldfish—nonnative	*Carassius auratus*	Central Valley rivers and reservoirs; Delta
Carp—nonnative	*Cyprinus carpio*	Central Valley rivers and reservoirs; Delta
Threadfin shad—nonnative	*Dorosoma petenense*	Central Valley rivers and reservoirs; Delta
American shad—nonnative	*Alosa sapidissima*	Central Valley rivers; Delta; San Francisco Bay estuary
Black bullhead—nonnative	*Ictalurus melas*	Central Valley rivers and reservoirs; Delta
Brown bullhead—nonnative	*Ictalurus nebulosus*	Central Valley rivers and reservoirs; Delta
White catfish—nonnative	*Ictalurus catus*	Central Valley rivers; Delta
Channel catfish—nonnative	*Ictalurus punctatus*	Central Valley rivers and reservoirs; Delta
Mosquito fish—nonnative	*Gambusia affinis*	Central Valley rivers and reservoirs; Delta
Inland silverside—nonnative	*Menidia audena*	Central Valley rivers; Delta
Threespine stickleback—native	*Gasterosteus aculaetus*	Central Valley rivers; Delta; San Francisco Bay estuary
Striped bass—nonnative	*Morone saxatilis*	Central Valley rivers and reservoirs; Delta; San Francisco Bay estuary
Bluegill—nonnative	*Lepomis macrochirus*	Central Valley rivers and reservoirs; Delta
Green sunfish—nonnative	*Lepomis cyanellus*	Central Valley rivers and reservoirs; Delta
Redear sunfish—nonnative	*Lepomis microlophus*	Central Valley rivers and reservoirs; Delta
Warmouth—nonnative	*Lepomis gulosus*	Central Valley rivers and reservoirs; Delta
White crappie—nonnative	*Pomoxis annularis*	Central Valley rivers and reservoirs; Delta
Black crappie—nonnative	*Pomoxis nigromaculatus*	Central Valley rivers and reservoirs; Delta
Largemouth bass—nonnative	*Micropterus salmoides*	Central Valley rivers and reservoirs; Delta
Redeye Bass--nonnative	*Micropterus coosae*	Central Valley rivers and reservoirs
Spotted bass—nonnative	*Micropterus punctulatus*	Central Valley rivers and reservoirs; Delta
Small mouth bass—nonnative	*Micropterus dolomieui*	Central Valley rivers and reservoirs; Delta
Bigscale logperch—nonnative	*Percina macrolepida*	Central Valley rivers; Delta
Yellowfin goby—nonnative	*Acanthogobius flavimanus*	Delta and San Francisco Bay estuary
Chameleon goby—nonnative	*Tridentiger trigonocephalus*	Delta and San Francisco Bay estuary
Prickly sculpin—native	*Cottus asper*	Central Valley rivers
Tule perch—native	*Hysterocarpus traskii*	Central Valley rivers; Delta

Life Histories

This section describes the key environmental requirements for each life stage of the selected species. Table 6.1-2 shows the assumed months for each life stage

Table 6.1-2. Assumed Life Stage Timing and Distribution of Selected Species Potentially Affected by the Proposed SDIP Alternatives

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Late Fall–Run Chinook Salmon													
Adult Migration	SF Bay to Upper Sac River and Tributaries, Mokelumne River, and SJR Tributaries	■	■								■	■	■
Spawning	Upper Sacramento River and Tributaries, Mokelumne River and SJR Tributaries	■	■	■									
Egg Incubation	Upper Sacramento River and Tributaries, Mokelumne River and SJR Tributaries	■	■	■	■	■							
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries, Mokelumne River and SJR Tributaries			■	■	■	■	■	■	■	■	■	
Juvenile Movement and Rearing	Upper Sacramento River and Tributaries, Mokelumne River and SJR Tributaries	■	■	■	■	■	■				■	■	■
Fall-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River and Tributaries							■	■	■	■	■	■
Spawning[1]	Upper Sacramento River and Tributaries										■	■	■
Egg Incubation[1]	Upper Sacramento River and Tributaries	■	■	■							■	■	■
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries	■	■	■	■	■	■						
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay		■	■	■	■	■						
Spring-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River and Tributaries			■	■	■	■	■	■	■			
Spawning	Upper Sacramento River and Tributaries								■	■	■		
Egg Incubation	Upper Sacramento River and Tributaries								■	■	■	■	■
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries	■	■	■	■	■	■	■	■	■	■	■	■

Table 6.1-2. Continued

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay												
Winter-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River												
Spawning	Upper Sacramento River												
Egg Incubation	Upper Sacramento River												
Juvenile Rearing (Natal Stream)	Upper Sacramento River to SF Bay												
Juvenile Movement and Rearing	Upper Sacramento River to SF Bay												
Steelhead													
Adult Migration	SF Bay to Upper Sacramento River and Tributaries												
Spawning	Upper Sacramento River and Tributaries												
Egg Incubation	Upper Sacramento River and Tributaries												
Juvenile Rearing	Upper Sacramento River and Tributaries to SF Bay												
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay												
Southern Oregon/Northern California Coasts Coho Salmon													
Adult Migration	Trinity River												
Juvenile Rearing	Trinity River												
Juvenile Movement	Trinity River												

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Splittail													
Adult Migration	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Sacramento River and SJR												
Spawning	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Lower Sacramento and SJ Rivers												
Larval and Early Juvenile Rearing and Movement	Suisun Marsh, Upper Delta, Yolo Bypass, Sutter Bypass, Lower Sacramento and San Joaquin Rivers												
Adult and Juvenile Rearing	Delta, Suisun Bay												
Delta Smelt													
Adult Migration	Delta												
Spawning	Delta, Suisun Marsh												
Larval and Early Juvenile Rearing	Delta, Suisun Marsh												
Estuarine Rearing: Juveniles and Adults	Lower Delta, Suisun Bay												

Notes:

SF Bay = San Francisco Bay.

SJR = San Joaquin River.

[1] Spawning and incubation occurs from October to February in the Feather, American, and Mokelumne Rivers

Sources: Brown 1991; Wang and Brown 1993; U.S. Fish and Wildlife Service 1996; McEwan 2001; Moyle 2002; Hallock 1989.

that were included in the calculations of habitat conditions for the SDIP alternatives. Actual occurrence and relative abundance may vary between months and from year to year.

Chinook Salmon

After 2–5 years in the ocean, adult Chinook salmon leave the ocean and migrate upstream in the Sacramento and San Joaquin rivers. The names of the Chinook salmon runs (i.e., fall, late fall, winter, and spring) reflect the variability in timing of the adult life stage (Table 6.1-2). Spawning occurs in the cool reaches of Central Valley rivers that are downstream of the terminal dams and in tributary streams. After the eggs hatch, juvenile Chinook salmon remain in fresh water for 3–14 months.

Historical records indicate that adult spring-run Chinook salmon enter the mainstem Sacramento River in March, and continue to their spawning streams where they hold until September in deep cold pools (Table 6.1-2). Spring-run Chinook salmon are sexually immature during their spawning migration. Spawning occurs in gravel beds in late August through October, and emergence begins in December. Spring-run Chinook salmon migrate downstream as young-of-year or yearling juveniles. Young-of-year juveniles move between February and June, and yearling juveniles migrate from October to March, with peak migration in November (Cramer, S.P. 1996).

Adult fall-/late fall–run Chinook salmon enter the Sacramento and San Joaquin River systems from July through February and spawn from October through March (Table 6.1-2). Optimal water temperatures for egg incubation is 44 to 54°F (6.7 to 12.2°C) (Rich 1997). Newly emerged fry remain in shallow, lower-velocity edgewaters (California Department of Fish and Game 1998). Juveniles migrate to the ocean from October to June (Table 6.1-2).

Adult winter-run Chinook salmon leave the ocean and migrate through the Delta into the Sacramento River from December through July (Table 6.1-2). Adults migrate upstream past RBDD on the Sacramento River from mid-December through July, and most (85%) of the spawning population has passed RBDD by mid-May, trailing off in late June (Table 6.1-2). Spawning takes place from mid-April through August, and incubation continues through October (Table 6.1-2). The primary spawning grounds in the Sacramento River are above RBDD. Juvenile winter-run Chinook salmon rear and migrate in the Sacramento River from July through March (Hallock and Fisher 1985; Smith pers. comm.). Juveniles move downstream in the Sacramento River above RBDD from August through October and possibly November, rearing as they move downstream. Juveniles have been observed in the Delta during October through December, especially during high Sacramento River discharge in response to fall and early-winter storms. Winter-run salmon juveniles migrate through the Delta to the ocean from December through as late as May (Stevens 1989).

During spawning, the female digs a redd (a nest in clean gravel) and deposits eggs. A male fertilizes the eggs during the creation of the redd. Optimal water temperature for egg incubation is 44 to 54°F (6.7 to 12.2°C) (Rich 1997). Newly emerged fry remain in shallow, lower-velocity edgewaters (California Department of Fish and Game 1998). Juveniles rear in their natal streams, the mainstem of the Sacramento River, and in the Delta.

Cover, space, and food are necessary components for Chinook salmon rearing habitat. Suitable habitat includes areas with instream and overhead cover in the form of cobbles, rocks, undercut banks, downed trees, and large, overhanging tree branches. The organic materials forming fish cover also provide sources of food, in the form of both aquatic and terrestrial insects.

Juvenile Chinook salmon move downstream in response to many factors, including inherited behavior, habitat availability, flow, competition for space and food, and water temperature. The number of juveniles that move and the timing of movement are highly variable. Storm events and the resulting high flows appear to trigger movement of substantial numbers of juvenile Chinook salmon to downstream habitats. In general, juvenile abundance in the Delta appears to be higher in response to increased flow (U.S. Fish and Wildlife Service 1993).

Steelhead

Steelhead have one of the most complex life histories of any salmonid species. Steelhead are anadromous, but some individuals may complete their life cycle within a given river reach. Freshwater residents typically are referred to as rainbow trout, while anadromous individuals are called steelhead (National Marine Fisheries Service 1996a).

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 (Table 6.1-2) (McEwan and Jackson 1994; Hallock 1989). Most steelhead spawn from December through April (Table 6.1-2), with most spawning occurring from January through March. Unlike Pacific salmon, some steelhead may survive to spawn more than one time, returning to the ocean between spawning migrations.

The female digs a redd in which she deposits her eggs. The duration of egg incubation in the gravel is determined by water temperature, varying from approximately 19 days at an average water temperature of 60°F (15.6°C) to approximately 80 days at an average temperature of 40°F (4.4°C). Steelhead fry usually emerge from the gravel 2 to 8 weeks after hatching (Barnhart 1986; Reynolds et al. 1993). Newly emerged steelhead fry move to 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 migration to the ocean generally occurs from December through August (Table 6.1-2). Most Sacramento River steelhead migrate in spring and early summer (Reynolds et al. 1993). Sacramento River steelhead generally migrate as 1-year-olds at a length of 6 to 8 inches (15.2 to 20.3 centimeters [cm]) (Barnhart 1986; Reynolds et al. 1993). Although steelhead have been collected in most months at the state and federal pumping plants in the Delta, the peak numbers salvaged at these facilities occur in March and April in most years.

After 2–3 years of ocean residence, adult steelhead return to their natal stream to spawn as 3- or 4-year-olds (National Marine Fisheries Service 1998).

Coho Salmon

Coho salmon are anadromous fish that migrate as adults into the Trinity River and other coastal streams and rivers to spawn. Adult migration occurs from mid-September through December, and spawning typically takes place between November and January (Table 6.1-2) (Moyle 2002). Coho salmon adults spawn in waters with velocities of 0.82–1.0 feet/sec (0.25–0.31 meter per second (m/sec) and depths of 11.8–12.2 inches (0.3–0.31 meter) (Hampton 1988). Redds are formed near the heads of riffles in medium-to-small gravel that provide good flow and aeration. Spawning occurs over about a week. Embryos hatch after 8–12 weeks depending on the water temperature, and remain in the gravel for 4–10 weeks until their yolk sacs are absorbed (Leidy and Leidy 1984). After hatching, the juveniles move to shallow water along the stream margins (Moyle 2002).

Habitat includes backwaters, side channels, and stream margins adjacent to large, slow runs or pools. Coho salmon will shift their habitat use depending on the season, but use mostly deep pools with overhead cover in the summer (Moyle 2002). Cover is the most important rearing habitat feature; coho salmon seek areas with overhanging vegetation (e.g., brush and logs) and thick clusters of aquatic vegetation (Hampton 1988). Optimal growth temperature ranges from 53.1 to 57°F (11.7 to 13.9°C), and they prefer velocities of 0.3 to 1.5 feet/sec (0.09 to 0.46 m/sec) (Moyle 2002). Juveniles are absent from tributaries that reach temperatures warmer than 64°F (17.8°C) for more than a week.

Juvenile coho salmon rear in tributary streams for up to 15 months before migrating to the ocean. Downstream migration occurs from March through May, with peak occurrence in late April through mid-May when conditions are favorable (Table 6.1-2) (Moyle 2002).

Delta Smelt

Estuarine rearing habitat for juvenile and adult delta smelt is typically found in the waters of the lower Delta and Suisun Bay where salinity is between 2 and 7 ppt. Delta smelt tolerate 0 ppt to 19 ppt salinity. They typically occupy open shallow waters but also occur in the main channel in the region where fresh water and brackish water mix. The zone may be hydraulically conducive to their ability to maintain position and metabolic efficiency (Moyle 2002).

Adult delta smelt begin spawning migration into the upper Delta beginning in December or January (Table 6.1-2). Migration may continue over several months. Spawning occurs between January and July, with peak spawning during April through mid-May (Moyle 2002). Spawning occurs in along the channel edges in the upper Delta, including the Sacramento River above Rio Vista, Cache Slough, Lindsey Slough, and Barker Slough. Spawning has been observed in the Sacramento River up to Garcia Bend during drought conditions, possibly attributable to adult movement farther inland in response to saltwater intrusion (Wang and Brown 1993). Eggs are broadcast over the bottom, where they attach to firm substrate, woody material, and vegetation. Hatching takes approximately 9 to 13 days, and larvae begin feeding 4 to 5 days later. Newly hatched larvae contain a large oil globule and are semibuoyant. Larval smelt feed on rotifers and other zooplankton. As their fins and swim bladder develop, they move higher into the water column. Larvae and juveniles gradually move downstream toward rearing habitat in the estuarine mixing zone (Wang 1986).

Critical Habitat

Critical habitat for delta smelt is designated as all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in the existing contiguous waters within Suisun Bay and the Delta (59 Federal Register [FR] 852; January 6, 1994). The primary constituent elements for the critical habitat are adult migration, spawning habitat, larval and juvenile transport, and rearing habitat and are described below:

- **Adult migration**—the Sacramento and San Joaquin River channels and tributaries, including Cache and Montezuma Sloughs and their tributaries. Unrestricted access must be provided to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality must be maintained, and channels should be protected from physical disturbance and flow disruption.
- **Spawning habitat**—fresh or slightly brackish backwater sloughs and edgewaters of the Delta, Suisun Bay, and Montezuma Slough and its tributaries. Spawning habitat must provide suitable water quality and substrates for egg attachment. Spawning may start as early as December and extend until July.
- **Larval and juvenile transport**—channels of the Delta, Suisun Bay, and Montezuma Slough and its tributaries must be protected from physical disturbance and flow disruption (e.g., water diversions and in-channel gates). Depending on the timing of peak spawning, channel flow must be adequate to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay and to prevent interception of larvae and juveniles by diversions.
- **Rearing habitat**—an area extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Threemile Slough, and south along the San Joaquin River, including Big Break.

Suitable water quality must be available, and X2 must be maintained according to historical salinity conditions. Rearing habitat protection may be required from the beginning of February through the summer.

All of the above critical habitat elements are addressed in the Environmental Consequences section. The environmental correlates used in this EIS/EIR reflect the primary constituent elements of critical habitat above.

Splittail

Adult splittail migrate from Suisun Bay and the Delta to upstream spawning habitat during December through March (Table 6.1-2). Surveys conducted indicate that 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; Moyle et al. 1989). Adhesive eggs are deposited over flooded terrestrial or aquatic vegetation when water temperature is between 48°F and 68°F (8.9°C and 20°C) (Moyle 2002; Wang 1986). Splittail spawn in late April and May in Suisun Marsh and between early March and May in the upper Delta and lower reaches and flood bypasses of the Sacramento and San Joaquin Rivers (Moyle et al. 1989). Spawning has been observed to occur as early as January and may continue through early July (Table 6.1-2) (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 splittail are commonly found in shallow, vegetated areas near spawning habitat. Larvae eventually move into deeper and more open-water habitat as they grow and become juveniles. During late winter and spring, young-of-year juvenile splittail (i.e., production from spawning in the current year) are found in sloughs, rivers, and Delta channels near spawning habitat (Table 6.1-2). 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).

Striped Bass

Striped bass are nonnative and spend most of their lives in San Pablo and San Francisco Bays and move upstream to spawn. Spawning peaks in May and June, and its location depends on water temperature, flow, and salinity. Spawning occurs in the Delta and in the Sacramento River during the spring. Striped bass are open-water spawners, and their eggs must remain suspended in the current to prevent mortality. Embryos and larvae in the Sacramento River are carried into the Delta and Suisun Bay where rearing appears to be best (Moyle 2002). Larval and juvenile striped bass feed mainly on invertebrates, including copepods and opossum shrimp. Fish become a more important part of their diet as they grow in size (Moyle 2002). Young striped bass tend to accumulate in or just upstream of the estuary's freshwater/saltwater mixing zone and this region is critical nursery habitat (California Department of Fish and Game 1991a). Female striped bass reach maturity at 4 to 6 years of age, and males can reach maturity as early as the end of their first year but most reach maturity at 2–3 years of age. Adult striped bass are open-water predators and opportunistic feeders at the top of the aquatic food web. (Moyle 2002.)

Striped bass populations in the Delta have been in steady decline since the late 1970s. A changing atmospheric-oceanic climate may be at the root of this decline. The decline in striped bass abundance may be related to increasing ocean temperatures (Bennett and Howard 1999).

Green Sturgeon

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 freshwater, green sturgeon occur in the lower reaches of large rivers from British Columbia south to the 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 distinct population segment consists of green sturgeon populations extending from the Eel River northward, while the southern distinct population segment includes populations extending from south of the Eel River to the Sacramento River. Spawning populations have only been confirmed, however, 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). Although no green sturgeon have ever been documented in the San Joaquin River upstream of the Delta, it is unclear whether they use this system for spawning; however, no efforts have been made to document sturgeon spawning in the San Joaquin River system (70 FR 17386). In the Trinity River, adult green sturgeon are known to occur as far upstream as Grays Falls (at River Mile [RM] 43), but there is no evidence of spawning upstream of RM 25 (Adams et al. 2002). There is no evidence that green sturgeon spawn in the South Fork Trinity River (Moyle et al. 1992b).

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. Green sturgeon are believed to spawn every 3 to 5 years (Tracy 1990), although recent evidence indicates that spawning may be as frequent as every 2 years (70 FR 17386). Little is known about the specific spawning habitat preferences of green sturgeon. It is believed that adult green sturgeon broadcast their eggs in deep, fast water over large cobble substrate where the eggs settle into the interstitial spaces (Moyle 2002). Spawning may also occur over substrates ranging from clean sand to bedrock (Moyle 2002). Eggs hatch in approximately 8 days at 55ºF (Moyle 2002).

Larval green sturgeon begin feeding 10 days after hatching, and metamorhosis to the juvenile stage is complete within 45 days of hatching. Larvae grow quickly, reaching 74 mm in the first 45 days after hatching and 300 mm by the end of the their first year. Juveniles spend 1 to 3 years in freshwater before they enter the ocean. (70 FR 17386.)

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 (IEP 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, at least in the south Delta, is low. The diet of adult green sturgeon seems to mostly include bottom invertebrates and small fish (Ganssle 1966). Juveniles in the Delta feed on opossum shrimp and amphipods (Radtke 1966).

Other Species

The species discussed above are explicitly included in the assessment of impacts for the SDIP. Central Valley rivers and reservoirs support many other native and nonnative fish species that may be affected by the SDIP (Table 6.1-1). These other species are not afforded legal protection and therefore are not discussed beyond this section. In general, the effects of the SDIP on other fish species are assumed to be similar and encompassed by the assessment for the selected species.

In general, native species, such as Sacramento pikeminnow, hardhead, Sacramento sucker, and California roach, spawn early in the spring. With some exceptions, nonnative species, such as green sunfish, bluegill, white and channel catfish, and largemouth bass, spawn later in the spring and in the summer. Nonnative species are more successful in disturbed environments than native species. In general, they are adapted to warm, slow-moving, and nutrient-rich waters (Moyle 2002). Nonnative species dominate the fish communities in the Delta and lower reaches of the Sacramento and San Joaquin Rivers and their tributaries.

Trinity, Shasta, Lewiston, Oroville, Folsom, Pardee, San Luis, New Melones, and Camanche Reservoirs support coldwater and warmwater fisheries that are composed primarily of nonnative fishes. Coldwater species include rainbow trout, kokanee, and brown trout. Warmwater species include largemouth bass, smallmouth bass and other sunfish, channel catfish and bullheads, and common carp. The exact species composition of each reservoir varies according to different species introductions and hatchery supplementation (Moyle 2002). Most reservoirs are relatively artificial ecosystems that rarely meet all the needs of the species present. Factors such as water-level fluctuation, limited cover and spawning habitat, and inadequate forage base may affect the reproductive success of reservoir species and the capacity for supporting sustainable populations. However, minimal changes in reservoir storage, especially for San Luis, result from SDIP operation (see Section 7.4) and, therefore, no change in reservoir fish numbers would be expected.

Factors That Affect Abundance of Fish Species

Information relating abundance with environmental conditions is most available for special-status species, especially Chinook salmon. The following section focuses on factors that have potentially affected the abundance of special-status species in the Central Valley. Although not all species are discussed, many of the factors affecting the special-status species have also affected the abundance of other native and nonnative species.

Spawning Habitat Area

Spawning habitat area may limit the production of juveniles and subsequent adult abundance of some species. Spawning habitat area for fall-/late fall–run Chinook salmon, which compose more than 90% of the Chinook salmon returning to the Central Valley streams, has been identified as limiting their population abundance. Spawning habitat area has not been identified as a limiting factor for the less-abundant winter-run and spring-run Chinook salmon (National Marine Fisheries Service 1996b; U.S. Fish and Wildlife Service 1996), although habitat may be limiting in some streams (e.g., Butte Creek) during years of high adult abundance.

Spawning habitat area is defined by a number of factors such as gravel size and quality and water depth and velocity. Although maximum usable gravel size depends on fish size, a number of studies have determined that Chinook salmon require gravel ranging from approximately 0.1 inch (0.3 cm) to 5.9 inches (15 cm) in diameter (Raleigh et al. 1986). Steelhead prefer substrate no larger than 3.9 inches (10 cm) (Bjornn and Reiser 1991). Water depth criteria for spawning vary widely, and there is little agreement among studies about the minimum and maximum values for depth (Healey 1991). Salmonids spawn in water depths that range from a few inches to several feet. A minimum depth of 0.8 foot (0.2 m) for Chinook salmon and steelhead spawning has been widely used in the literature and is within the range observed in some Central Valley rivers (California Department of Fish and Game 1991b). In general, water should be at least deep enough to cover the adult fish during spawning. Minimum water depth for steelhead spawning has been observed to be enough to cover the fish (Bjornn and Reiser 1991). Many fish spawn in deeper water. Velocity that supports spawning ranges from 0.8 feet/sec to 3.8 feet/sec (0.2 to 1.2 m/sec) (U.S. Fish and Wildlife Service 1994).

Delta smelt spawn in fresh water at low tide on aquatic plants, submerged and inshore plants, and over sandy and hard bottom substrates of sloughs and shallow edges of channels in the upper Delta and Sacramento River above Rio Vista (Wang 1986; Moyle 2002). Spawning habitat area has not been identified as a factor affecting delta smelt abundance (U.S. Fish and Wildlife Service 1996), but little is known about specific spawning areas and requirements within the Delta.

A lack of sufficient seasonally flooded vegetation may limit splittail spawning success (Young and Cech 1996; Sommer et al. 1997). Splittail spawn over flooded vegetation and debris on floodplains that are inundated by high flow from February to early July in the Sacramento River and San Joaquin River systems. The onset of spawning appears to be associated with rising water levels, increasing water temperature, and day length (Moyle 2002). The Sutter and Yolo Bypasses along the Sacramento River are important spawning habitat areas during high flow.

Green sturgeon spawn in deep, fast water. Spawning substrate can range from clean sand to bedrock, although the preferred substrate is probably large cobble. Currently, spawning takes place in the Sacramento, Klamath, and Rogue (Oregon) Rivers and may be the only spawning populations left in North America (Moyle 2002). Spawning habitat area has not been defined as a factor affecting abundance for green sturgeon. However, little is known about specific habitat requirements for wild spawning green sturgeon.

Rearing Habitat Area

Rearing habitat area may limit the production of juveniles and subsequent adult abundance of some species. The USFWS (1996) has indicated rearing habitat area in Central Valley streams and rivers limits the abundance of juvenile fall-run and late fall–run Chinook salmon and juvenile steelhead. Rearing habitat for salmonids is defined by environmental conditions such as water temperature, DO, turbidity, substrate, water velocity, water depth, and cover (Jackson 1992; Bjornn and Reiser 1991; Healey 1991). Chinook salmon also rear along the shallow vegetated edges of Delta channels (Grimaldo et al. 2000).

Environmental conditions and interactions between individuals, predators, competitors, and food sources determine habitat quantity and quality and the productivity of the stream (Bjornn and Reiser 1991). Everest and Chapman (1972) found juvenile Chinook salmon and steelhead of the same size using similar in-channel rearing area. Juvenile coho salmon use side-channel pools. Coho salmon prefer low velocity areas with good cover, especially in the winter (Bjornn and Reiser 1991).

Rearing area varies with flow. High flow increases the area available to juvenile Chinook salmon because they extensively use submerged terrestrial vegetation on the channel edge and the floodplain. Deeper inundation provides more overhead cover and protection from avian and terrestrial predators than shallow water (Everest and Chapman cited in Jackson 1992). In broad, low-gradient rivers, change in flow can greatly increase or decrease the lateral area available to juvenile Chinook salmon, particularly in riffles and shallow glides (Jackson 1992).

Rearing habitat for larval and early juvenile delta smelt encompasses the lower reaches of the Sacramento River below Isleton and the San Joaquin River below Mossdale. Estuarine rearing by juveniles and adults occurs in the lower Delta and Suisun Bay. The USFWS (1996) has indicated that loss of rearing habitat area would adversely affect the abundance of larval and juvenile delta smelt. The area and quality of estuarine rearing habitat is assumed to be dependent on the downstream location of approximately 2 ppt salinity (Moyle et al. 1992a). The condition where 2 ppt salinity is located in the Delta is assumed to provide less habitat area and lower quality than the habitat provided by 2 ppt salinity located farther downstream in Suisun Bay. During years of average and high outflow, delta smelt may concentrate anywhere from the Sacramento River around Decker Island to Suisun Bay (Moyle 2002). This geographic distribution may not always be a function of outflow and 2 ppt isohaline position. Outflow and the position of the 2 ppt isohaline may account for only about 25% of the annual variation in abundance indices for delta smelt (California Department of Water Resources and Bureau of Reclamation 1994).

Rearing habitat has not been identified as a limiting factor in splittail population abundance, but as with spawning, a lack of sufficient seasonally flooded vegetation may be limiting population abundance and distribution (Young and Cech 1996). Rearing habitat for splittail encompasses the Delta, Suisun Bay, Suisun Marsh, the lower Napa River, the lower Petaluma River, and other parts of San Francisco Bay (Moyle 2002). In Suisun Marsh, splittail concentrate in the dead-end sloughs that have small streams feeding into them (Daniels and Moyle 1983; Moyle 2002). As splittail grow, salinity tolerance increases (Young and Cech 1996). Splittail are able to tolerate salinity concentrations as high as 29 ppt and as low as 0 ppt (Moyle 2002).

Juvenile green sturgeon prefer deeper areas with rock structures to hide during the day, and forage and migrate at night (Kynard et al. 2005). Little is known about rearing habitat requirements for juvenile green sturgeon and has not been identified as a limiting factor in sturgeon population abundance.

Migration Habitat Conditions

The Sacramento, Feather, Yuba, American, and Mokelumne rivers and the Delta provide a migration pathway between freshwater and ocean habitats for adult and juvenile steelhead and all runs of Chinook salmon. The Trinity River provides a migration pathway for coho salmon, Chinook salmon, and steelhead.

Migration habitat conditions include streamflows that provide suitable water velocities and depths that provide successful passage. Flow in the Sacramento, Feather, Yuba, American, and Mokelumne rivers and in the Delta provide the necessary depth, velocity, and water temperature. Within the Delta, the channel pathways affect migration of juvenile Chinook salmon. Juvenile Chinook salmon survival is lower for fish migrating through the central Delta (i.e., diverted into the DCC and Georgiana Slough) than for fish continuing down the Sacramento River (Newman and Rice 1997). Similarly, juvenile Chinook salmon entering the Delta from the San Joaquin River appear to have higher survival if they remain in the San Joaquin River channel instead of moving into Old River and the south Delta (Brandes and McLain 2001).

Larval and early juvenile delta smelt are transported by currents that flow downstream into the upper end of the mixing zone of the estuary where incoming saltwater mixes with outflowing fresh water (Moyle et al. 1992a). Reduced flow may adversely affect transport of larvae and juveniles to rearing habitat.

Adult splittail gradually move upstream during the winter and spring months to spawn. Year class success of splittail is positively correlated with wet years, high Delta outflow, and floodplain inundation (Sommer et al. 1997; Moyle 2002). Low flow impedes access to floodplain areas that support rearing and spawning.

Green sturgeon adults and juveniles seem to prefer deeper water habitat such as pools. Lower flows could impede upstream migration of adults if low flow conditions cause barriers for migration.

Water Temperature

Fish species have different responses to water temperature conditions depending on their physiological adaptations. Salmonids in general have evolved under conditions in which water temperatures need to be relatively cool. Delta smelt and splittail can tolerate warmer temperatures. In addition to species-specific thresholds, different life stages have different water temperature requirements. Eggs and larval fish are the most sensitive to warm water temperature.

Unsuitable water temperatures for adult salmonids such as Chinook salmon, steelhead, and coho salmon during upstream migration lead to delayed migration and potential lower reproduction. Elevated summer water temperatures in holding areas cause mortality of spring-run Chinook salmon (U.S. Fish and Wildlife Service 1996). Warm water temperature and low DO also increase egg and fry mortality. The USFWS (1996) cited elevated water temperatures as limiting factors for fall and late fall–run Chinook salmon.

Juvenile salmonid survival, growth, and vulnerability to disease are affected by water temperature. In addition, water temperature affects prey species abundance and predator occurrence and activity. Juvenile salmonids alter their behavior depending on water temperature, including movement to take advantage of local water temperature refugia (e.g., movement into stratified pools, shaded habitat, and subsurface flow) and to improve feeding efficiency (e.g., movement into riffles).

Water temperature in Central Valley rivers frequently exceeds the tolerance of Chinook salmon and steelhead life stages. Based on a literature review, conditions supporting adult Chinook salmon migration are assumed to deteriorate as temperature warms between 54ºF and 70ºF (12.2°C and 21.1°C) (Hallock 1970 as cited in McCullough 1999). For Chinook salmon eggs and larvae, survival during incubation is assumed to decline with increasing temperature between 54ºF and 61ºF (12.2°C and 16.1°C). (Myrick and Cech 2001; Seymour 1956 cited in Alderice and Velsen 1978). For juvenile Chinook salmon, survival is assumed to decline as temperature warms from 64ºF to 75ºF (17.8°C to 23.9°C) (Myrick and Cech 2001; Rich 1987). Relative to rearing, Chinook salmon require cooler temperatures to complete the parr-smolt transformation and to maximize their saltwater survival. Successful smolt transformation is assumed to deteriorate at temperatures ranging from 63ºF to 73ºF (17.2°C to 22.8°C) (Marine 1997 cited in Myrick and Cech 2001; Baker et al. 1995).

For steelhead, successful adult migration and holding is assumed to deteriorate as water temperature warms between 52ºF and 70ºF (11.1°C and 21.1°C). Adult steelhead appear to be much more sensitive to thermal extremes than are juveniles (National Marine Fisheries Service 1996a; McCullough 1999). Conditions supporting steelhead spawning and incubation are assumed to deteriorate as temperature warms between 52ºF and 59ºF (11.1°C and 15°C) (Myrick and Cech 2001). Juvenile rearing success is assumed to deteriorate at water temperatures ranging from 63ºF to 77ºF (17.2°C to 25°C) (Raleigh et al. 1984; Myrick and Cech 2001). Relative to rearing, smolt transformation requires cooler temperatures, and successful transformation occurs at temperatures ranging from 43ºF to 50ºF (6.1°C to 10°C). Juvenile steelhead, however, have been captured at Chipps Island in June and July at water temperatures exceeding 68ºF (Nobriega and Cadrett 2001). Juvenile Chinook salmon have also been observed to migrate at water temperatures warmer than expected based on laboratory experimental results (Baker et al. 1995).

Delta smelt and splittail populations are adapted to water temperature conditions in the Delta. Delta smelt may spawn at temperatures as high as 72ºF (22.2°C) (U.S. Fish and Wildlife Service 1996) and can rear and migrate at temperatures as warm as 82ºF (Swanson and Cech 1995). Splittail may withstand temperatures as warm as 91ºF but prefer temperatures between 66ºF and 75ºF (18.9°C and 23.9°C) (Young and Cech 1996).

Green sturgeon prefer cool water temperatures for spawning, embryonic development and rearing. Spawning typically occurs when water temperatures are 46–57°F and embryonic development is optimal when water temperatures are 52–66°F. Temperatures above 68°F are lethal for embryos (Cech et al. 2000). Overwintering juveniles stop migrating downstream when temperatures reach 46°F (Kynard et al. 2005).

Entrainment

All fish species are entrained to varying degrees by the SWP and CVP Delta export facilities and other diversions in the Delta and Central Valley rivers. Fish entrainment and subsequent mortality is a function of the size of the diversion, the location of the diversion, the behavior of the fish, and other factors, such as fish screens, presence of predatory species, and water temperature. Low approach velocities are assumed to minimize stress and protect fish from entrainment.

Juvenile striped bass populations have steadily declined since the mid-1960s partially because of entrainment losses of eggs and young fish at water diversions (Foss and Miller 2001). The CVP and SWP fish facilities indicate entrainment of adult delta smelt during spawning migration from December through April (California Department of Water Resources and Bureau of Reclamation 1994). Juveniles are entrained primarily from April through June. Young-of-year splittail are entrained between April and August when fish are moving downstream into the estuary (Cech et al. 1979 as cited in Moyle 2002). Juvenile Chinook salmon are entrained in all months but primarily from November through June when juveniles are migrating downstream. Green sturgeon are rarely entrained at the CVP and SWP fish facilities; however, entrainment has occurred in every month (IEP 2005).

Contaminants

In the Sacramento and San Joaquin River basins, industrial and municipal discharge and agricultural runoff introduce contaminants into rivers and streams that ultimately flow into the Delta. Organophosphate insecticides, such as carbofuran, chlorpyrifos, and diazinon, are present throughout the Central Valley and are dispersed in agricultural and M&I runoff. These contaminants enter rivers in winter runoff and enter the estuary in concentrations that can be toxic to invertebrates (CALFED Bay-Delta Program 2000d). Because they accumulate in living organisms, they may become toxic to fish species, especially those life stages that remain in the system year-round and spend considerable time there during the early stages of development such as Chinook salmon, steelhead, splittail, delta smelt, and green sturgeon.

Predation

Nonnative species cause substantial predation mortality on native species. Studies at CCF estimated predator-related mortality of hatchery-reared fall-run Chinook salmon from about 60% to more than 95%. Although the predation contribution to mortality is uncertain, the estimated mortality suggests that striped bass and other predatory fish, primarily nonnative, pose a threat to juvenile Chinook salmon moving downstream, especially where the stream channel has been altered from natural conditions (California Department of Water Resources 1995d). Turbulence after passing over dams and other structures may disorient juvenile Chinook salmon and steelhead, increasing their vulnerability to predators. Predators such as striped bass, largemouth bass, and catfish also prey on delta smelt and splittail (U.S. Fish and Wildlife Service 1996). However, the extent that these predators may affect delta smelt and splittail populations is unknown. Predation is not a known cause for decline in green sturgeon populations (Adams et al. 2002).

Food

Food availability and type affect survival of fish species. Species such as threadfin shad and wakasagi may affect delta smelt survival through competition for food. Introduction of nonnative food organisms may also have an effect on delta smelt and other species survival. Nonnative zooplankton species are more difficult for small smelt and striped bass to capture, increasing the likelihood of larval starvation (Moyle 2002). Splittail feed on opossum shrimp, which in turn feed on native copepods that have shown reduced abundance, potentially attributable to the introduction of nonnative zooplankton and the Asiatic clam *Potamorcorbula amurensis*. In addition, flow affects the abundance of food in rivers, the Delta, and Suisun Bay. In general, higher flows result in higher productivity, including the higher input of nutrients from channel margin and floodplain inundation and higher production resulting when low salinity occurs in the shallows of Suisun Bay. Higher productivity increases the availability of prey organisms for delta smelt and other fish species.

Environmental Consequences

Assessment Approach and Methods

The assessment of effects considers the occurrence and potential occurrence of species and species' life stages relative to the magnitude, timing, frequency, and duration of project activities, including construction and operation of gates in the south Delta, dredging, and water supply operations. The assessment links project actions to changes in environmental correlates, where environmental correlates are environmental conditions or suites of environmental conditions that individually or synergistically affect the survival, growth, fecundity, and movement of a species. Environmental correlates addressed in this assessment include spawning habitat quantity, rearing habitat quantity, migration habitat condition, water temperature, food, and entrainment in diversions (Table 6.1-3).

The assessment of a species response to project actions begins with statements of the hypothetical relationships between changes in environmental correlates and the expected species response. The underlying principles, specific methods, and available scientific support are discussed. Additional supporting information relative to species occurrence, life history, biology and physiology, and factors that have affected the historical and current species abundance is provided in Affected Environment.

Table 6.1-3. Summary of Assessment Models and Tools by Environmental Correlate for Each Fish Species and Life Stage

Assessed Environmental Correlate	Simulated Environmental Condition	Models Used to Simulate Environmental Conditions	Analytical Tool	Species: Life Stage
Spawning Habitat Quantity	River Flow—Trinity River	CALSIM, Water years 1922–1994	Qualitative assessment of flow effects	Coho Salmon: spawning and incubation
	River Flow—Sacramento River at Keswick Dam, Colusa, and Verona	CALSIM, Water years 1922–1994	Flow-habitat relationship for salmon and steelhead; high flow assessment of floodplain inundation for splittail	Winter-run Chinook Salmon: spawning and incubation
				Spring-run Chinook Salmon: spawning and incubation
				Fall-run Chinook Salmon: spawning and incubation
				Late fall–run Chinook Salmon: spawning and incubation
				Steelhead: spawning and incubation
				Splittail: spawning and incubation
	River Flow—Feather River	CALSIM, Water years 1922–1994	Flow-habitat relationship	Spring-run Chinook Salmon: spawning and incubation
				Fall-run Chinook Salmon: spawning and incubation
				Steelhead: spawning and incubation
	River Flow—American River	CALSIM, Water years 1922–1994	Flow-habitat relationship	Fall-run Chinook Salmon: spawning and incubation
				Steelhead: spawning and incubation
	River Flow—San Joaquin	CALSIM, Water years 1922–1994	Qualitative assessment of flow effect	Fall-run Chinook Salmon: spawning and incubation
				Steelhead: spawning and incubation
	Delta Outflow (and X2)	CALSIM, Water years 1922–1994	Qualitative assessment of change in freshwater area in the Delta	Delta Smelt: spawning
				Striped Bass: spawning
	Reservoir Storage—Trinity, Shasta, Oroville, and Folsom	CALSIM, Water years 1922–1994	Qualitative assessment of changes in reservoir storage effects	Reservoir species: spawning and incubation

Table 6.1-3. Continued

Assessed Environmental Correlate	Simulated Environmental Condition	Models Used to Simulate Environmental Conditions	Analytical Tool	Species: Life Stage
Rearing Habitat Quantity	River Flow—Trinity River	CALSIM, Water years 1922–1994	Qualitative assessment of flow effects	Coho Salmon: juvenile
	River Flow—Sacramento River at Keswick Dam, Colusa, and Verona	CALSIM, Water years 1922–1994	Low flow assessment based on flow-habitat relationship for salmon and steelhead; high flow assessment based on floodplain inundation for salmon and splittail	Winter-run Chinook Salmon: juvenile Spring-run Chinook Salmon: juvenile Fall-run Chinook Salmon: juvenile Late fall–run Chinook Salmon: juvenile Steelhead: juvenile Splittail: juvenile
	River Flow—Feather River	CALSIM, Water years 1922–1994	Low flow assessment based on flow-habitat relationship	Spring-run Chinook Salmon: juvenile Fall-run Chinook Salmon: juvenile Steelhead: juvenile
	River Flow—American River	CALSIM, Water years 1922–1994	Low flow assessment based on flow-habitat relationship	Fall-run Chinook Salmon: juvenile Steelhead: juvenile
	River Flow—San Joaquin	CALSIM, Water years 1922–1994	Qualitative assessment of flow effects	Fall-run Chinook Salmon: juvenile Steelhead: juvenile
	Delta Outflow (and X2)	CALSIM, Water years 1922–1994	Change in rearing habitat area based on location of X2	Delta Smelt: juvenile and adult Striped Bass: juvenile
	Reservoir Storage—Trinity, Shasta, Oroville, and Folsom	CALSIM, Water years 1922–1994	Qualitative assessment of reservoir storage effects	Reservoir species: juvenile

Assessed Environmental Correlate	Simulated Environmental Condition	Models Used to Simulate Environmental Conditions	Analytical Tool	Species: Life Stage
Migration Habitat Conditions	River Flow—Sacramento River	CALSIM, Water years 1922–1994	Assessment of floodplain inundation for splittail; assessment of low flow effects for striped bass	Splittail: adult Striped Bass: egg and larvae
	Delta Channel Flows—Sacramento River, Delta Cross Channel, and Georgiana Slough	CALSIM, Water years 1922–1994	Pathway-survival relationship for chinook salmon and steelhead	Winter-run Chinook Salmon: juvenile Spring-run Chinook Salmon: juvenile Fall-run Chinook Salmon: juvenile Late fall–run Chinook Salmon: juvenile Steelhead: juvenile
	Delta Channel Flows—San Joaquin River and head of Old River	CALSIM, Water years 1922–1994	Pathway-survival relationship for chinook salmon and steelhead	Fall-run Chinook Salmon: juvenile Steelhead: juvenile
	Delta Channel Flows—South Delta	DWRDSM2	Qualitative assessment based on gate elevation and tidal flow volume	Fall-run chinook salmon: juvenile Delta Smelt: adult and larvae
	Dissolved Oxygen—San Joaquin River at Stockton	CALSIM, Water years 1922–1994; DWRDSM2	Qualitative assessment based on flow at Stockton	Fall-run Chinook Salmon: adult Steelhead: adult

Assessed Environmental Correlate	Simulated Environmental Condition	Models Used to Simulate Environmental Conditions	Analytical Tool	Species: Life Stage
Water Temperature	Water Temperature—Trinity River	CALSIM, Water years 1922–1994; U.S. Bureau of Reclamation Monthly Water Temperature Model	Temperature-survival relationship	Coho Salmon: adult, incubation, juvenile, smolt
	Water Temperature—Sacramento River at Keswick Dam, Bend Bridge, and Red Bluff Diversion Dam	CALSIM, Water years 1922–1994; U.S. Bureau of Reclamation Monthly Water Temperature Model	Temperature-survival relationship	Winter-run Chinook Salmon: adult, incubation, juvenile, smolt Spring-run Chinook Salmon: adult, incubation, juvenile, smolt Fall-run Chinook Salmon: adult, incubation, juvenile, smolt Late fall–run Chinook Salmon: adult, incubation, juvenile, smolt Steelhead: adult, incubation, juvenile, smolt
	Water Temperature—Feather River	CALSIM, Water years 1922–1994; U.S. Bureau of Reclamation Monthly Water Temperature Model	Temperature-survival relationship	Spring-run Chinook Salmon: adult, incubation, juvenile, smolt Fall-run Chinook Salmon: adult, incubation, juvenile, smolt Steelhead: adult, incubation, juvenile, smolt
	Water Temperature—American River	CALSIM, Water years 1922–1994; U.S. Bureau of Reclamation Monthly Water Temperature Model	Temperature-survival relationship	Fall-run Chinook Salmon: adult, incubation, juvenile, smolt Steelhead: adult, incubation, juvenile, smolt
	River Flow—San Joaquin	CALSIM, Water years 1922–1994	Qualitative assessment of potential water temperature effects	Fall-run Chinook Salmon: adult, incubation, juvenile, smolt Steelhead: adult, incubation, juvenile, smolt

Assessed Environmental Correlate	Simulated Environmental Condition	Models Used to Simulate Environmental Conditions	Analytical Tool	Species: Life Stage
Food	River Flow—Trinity River	CALSIM, Water years 1922–1994	Qualitative assessment of flow effect	Coho Salmon: rearing
	River Flow—Sacramento River at Keswick Dam, Colusa, and Verona	CALSIM, Water years 1922–1994	Qualitative assessment of flow effect; high flow assessment of floodplain inundation	Winter-run Chinook Salmon: rearing Spring-run Chinook Salmon: rearing Fall-run Chinook Salmon: rearing Late fall–run Chinook Salmon: rearing Steelhead: in-river rearing Splittail: rearing
	River Flow—Feather River	CALSIM, Water years 1922–1994	Qualitative assessment of flow effect	Spring-run Chinook Salmon: rearing Fall-run Chinook Salmon: rearing Steelhead: rearing
	River Flow—American River	CALSIM, Water years 1922–1994	Qualitative assessment of flow effect	Fall-run Chinook Salmon: rearing Steelhead: rearing
	River Flow—San Joaquin	CALSIM, Water years 1922–1994	Qualitative assessment of flow effect	Fall-run Chinook Salmon: rearing Steelhead: rearing
	Delta Outflow (and X2)	CALSIM, Water years 1922–1994	Qualitative assessment of change X2 location	Delta Smelt: rearing Striped Bass: rearing
Entrainment in Delta diversions	SWP and CVP Exports; particle transport	CALSIM, Water years 1922–1994; DWRDSM2; Particle Tracking Model (DSM2-PTM)	Export volume-entrainment loss relationships; particle transport-entrainment loss relationships for passive and active fish behavior	Winter-run Chinook Salmon: juvenile Spring-run Chinook Salmon: juvenile Fall-run Chinook Salmon (from Sacramento, Mokelumne, and San Joaquin Rivers): juvenile Late fall–run Chinook Salmon: juvenile Steelhead: juvenile Delta Smelt: adult, larvae, juvenile Splittail: juvenile Striped Bass: egg, larvae, juvenile

Breadth of the Assessment

The SDIP may include construction of gates, dredging, and changes in exports and inflows that could affect environmental conditions within the Delta. Changes in water supply operations (i.e., Delta exports and inflows) potentially affect environmental conditions in the Sacramento River downstream of Keswick Dam, the American River downstream of Nimbus Dam, the Feather River downstream of the Thermalito Diversion Dam, the Trinity River downstream of Lewiston Reservoir, and Folsom, Oroville, Shasta and Trinity Reservoirs. The potential changes in water supply operations, affecting river flows, reservoir operations, and diversions and exports, are simulated by CALSIM over a range of conditions represented by the 1922–1994 hydrology (Section 5.1, Water Supply). The 1922–1994 hydrologies include wet and dry conditions and provide an indication of operations effects over variable sequences of hydrologic year types. The assessment of the effects of changes in water supply operations on fish species relies primarily on the simulated hydrology (Table 6.1-3).

This assessment focuses primarily on fish species listed under the ESA and CESA. Assessment methods have been developed to address effects on southern Oregon/northern California coasts coho salmon (i.e., Trinity River), Central Valley steelhead, Central Valley fall-/late fall–run Chinook salmon, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, delta smelt, splittail, striped bass, and green sturgeon (Table 6.1-3). Assessment methods are generally life stage specific.

Although not all fish species potentially affected are specifically included in the assessment, the response of the selected species to project actions provides an indication of the potential response by species with similar environmental needs. Where the analysis for the selected species does not capture the potential project effects on another species (e.g., reservoir species), specific effects on the other species are described.

Analytical Tools and Measures of Species Response

This section describes the tools applied to assess the potential effects of the SDIP on fish and other aquatic species (Table 6.1-3). Tools are identified for assessment of change in environmental correlates potentially affected by SDIP project actions that could cause a measurable species response (i.e., a measurable change in survival, growth, fecundity, and movement).

Conceptual models illustrate the environmental correlates identified for each life stage of delta smelt, Chinook salmon, and splittail (Figures 6.1-1, 6.1-2, and 6.1-3). Conceptual models are not provided for coho salmon, steelhead, striped bass, and green sturgeon. The conceptual models for coho salmon and steelhead would be similar to the model for Chinook salmon (Figure 6.1-2). The conceptual model for striped bass would be similar to the model for delta smelt (Figure 6.1-1), except that migration habitat condition is a "key" environmental correlate for the incubation life stage of striped bass (i.e., the eggs are semibuoyant and drift with flow). In addition, striped bass spawn in the lower Sacramento River and its tributaries as well as in the Delta. The conceptual model for green sturgeon is assumed to be encompassed by the models for delta smelt, Chinook salmon, and splittail combined.

Environmental correlates are expressed as some measurement unit, including linear feet or acres of habitat, degrees Fahrenheit, feet per second, thousand acre feet, cubic feet per second, and number of particles entrained. Hypotheses of the species response to variation in environmental correlates are identified for applicable species' life stages (Table 6.1-4) and are translated into equations or models that indicate the species response. The response of each species to change in environmental correlates is determined by the ecology and physiology of a species' life stage.

Measures of a species response to changes in environmental correlates ideally quantify predicted survival, growth, fecundity, and movement. Predicted survival and fecundity support the assessment of changes in a species' population abundance that facilitate the determination of impact significance (see Significance Criteria, below).

When feasible, change in an environmental correlate is related to effects on survival or fecundity. The relationship of change in an environmental correlate to a species response may be accomplished through various means. A model may estimate survival or fecundity. A water temperature-survival relationship is one example of a survival model. Another example of a survival model is the particle-tracking model that can be used to estimate entrainment of particles in diversions. The proportion of particles entrained may be assumed equivalent to entrainment-related mortality.

Existing tools may not quantify the potential change in survival or fecundity. Consequently, assessment of the change in survival and fecundity may be based on professional judgment and qualitative interpretation of the species responsiveness to changes in environmental conditions. For example, the responsiveness of a species to change in an environmental correlate could be described as ranging from low to very high (Table 6.1-5). Where appropriate, these ranges of responsiveness are used in the description of the assessment relationships for each species.

Table 6.1-4. Hypotheses and Measures of Species Response for All Environmental Correlates and Selected Species

Environmental Correlate	Species	Hypothesis Relating Change in the Environmental Correlate to a Species Response
Spawning Habitat Area	Chinook salmon	Spawning habitat area is a function of flow and reduced spawning habitat area will result in reduced fry production
	Steelhead	Spawning habitat area is a function of flow and reduced spawning habitat area will result in reduced fry production
	Delta smelt	Reduced spawning habitat area in response to flow (i.e., salinity intrusion) and physical disturbance will result in reduced larvae production
	Splittail	Spawning habitat area is a function of floodplain and bypass inundation and reduced spawning habitat area will result in reduced juvenile production
	Striped Bass	Reduced spawning habitat area in response to flow (i.e., salinity intrusion) and physical disturbance will result in reduced larvae production
Rearing Habitat Area	Chinook salmon	Rearing habitat area within the stream channel is a function of flow and reduced rearing habitat area will result in reduced juvenile production
		Rearing habitat area is a function of floodplain and bypass inundation and reduced rearing habitat area will result in reduced juvenile production
	Steelhead	Rearing habitat area within the stream channel is a function of flow and reduced rearing habitat area will result in reduced juvenile production
	Delta smelt	Reduced rearing habitat area in response to flow (i.e., estuarine salinity distribution) will result in reduced juvenile production
	Splittail	Rearing habitat area is a function of floodplain and bypass inundation and reduced rearing habitat area will result in reduced juvenile production
	Striped bass	Reduced rearing habitat area in response to flow (i.e., estuarine salinity distribution) will result in reduced juvenile production
Migration Habitat Conditions	Chinook salmon	Low dissolved oxygen conditions in the San Joaquin River channel near Stockton can delay adult migration and reduce spawning success
		Juvenile chinook salmon survival is lower for fish migrating into the Delta Cross Channel (DCC) and Georgiana Slough
		Juvenile chinook salmon survival is lower for fish migrating into Old River near Mossdale
	Steelhead	Same as chinook salmon

Table 6.1-4. Continued

Environmental Correlate	Species	Hypothesis Relating Change in the Environmental Correlate to a Species Response
	Delta smelt	A clear relationship has not been supported by the available data
	Splittail	Migration habitat conditions are a function of floodplain and bypass inundation and spawning success declines with reduced duration of inundation
	Striped bass	Egg survival is lower when Sacramento River inflow to the Delta is low
Water Temperature	Chinook salmon	Survival declines with increasing water temperature
	Steelhead	Survival declines with increasing water temperature
	Delta smelt	Not considered
	Splittail	Not considered
	Striped bass	Not considered
Food	Chinook salmon	Food production is a function of wetted channel area and inundated floodplain area and reduced food availability reduces survival
	Steelhead	Food production is a function of wetted channel area and reduced food availability reduces survival
	Delta smelt	An upstream shift in X2 results in lower food production and reduced food availability reduces survival
	Splittail	Food production is a function of inundated floodplain area and reduced food availability reduces survival
	Striped bass	An upstream shift in X2 results in lower food production and reduced food availability reduces survival
Entrainment	Chinook salmon	Entrainment loss is directly related to SWP and CVP pumping and an assumed density of fish in the water diverted
	Steelhead	Entrainment loss is directly related to SWP and CVP pumping and an assumed density of fish in the water diverted
	Delta smelt	Entrainment loss is directly related to SWP and CVP pumping and an assumed density of fish in the water diverted
	Splittail	Entrainment loss is directly related to SWP and CVP pumping and an assumed density of fish in the water diverted
	Striped bass	Entrainment loss is directly related to SWP and CVP pumping and an assumed density of fish in the water diverted

Table 6.1-5. Species Responsiveness to Change in an Environmental Correlate

Response	Definition
Low	Change in an environmental correlate causes a relatively small species response. Fecundity or life stage survival is expected to change by less than 2.5% in response to a 10% or larger change in an environmental correlate. Although the species response may be minimally affected by small changes in an environmental correlate (<10% change), significant impacts may result from larger changes.
Medium	Change in an environmental correlate causes a moderate response. Change in fecundity or life stage survival is approximately proportionate to change in the environmental correlate. That is, a 10% change in an environmental correlate would result in a 10% change in survival or fecundity.
High	Change in an environmental correlate causes a large species response. Fecundity or life stage survival is expected to change by more than 10% and up to 20% in response to a 10% change in an environmental correlate.
Very High	Change in an environmental correlate causes a very large species response. Change in fecundity or life stage survival may exceed 20% in response to a 10% change in the environmental correlate.

A discussion of certainty is included in the description of the assessment relationships and the expected species response for each environmental correlate. The description of certainty is qualitative, ranging from minimal to high (Table 6.1-6). Certainty is an important component in the assessment of impact significance (see Significance Criteria section) and in the development of effective mitigation of significant project impacts, including avoidance, minimization, and compensation measures.

Certainty indicates the potential that the species response or an index of the species response is reliable, adequate, accurate, and precise. An indication of certainty is the scientific support for the hypotheses, ranging from speculative relationships (minimal certainty) to those relationships that are thoroughly established, generally accepted, and supported by peer-reviewed evidence (high certainty). Certainty is also related to the accuracy and precision of measured or simulated environmental conditions and the resulting index of the species response.

Table 6.1-6. Certainty of the Assessment Relationships

Level of Certainty	Definition
Minimal	The relationship is speculative and has little empirical support.
Low	Some evidence from experiments and observation supports the theoretical relationship for cause and effect. The magnitude of species response cannot reliably be predicted from a given magnitude change in an environmental correlate. Contradictory theoretical relationships may be equally supported.
Medium	Evidence from experiments and observations support the theoretical relationship for cause and effect. The magnitude of species response can be predicted from a given magnitude change in an environmental correlate. The accuracy and precision of the relationship has not been statistically evaluated. Contradictory theoretical relationships are possible, but they are unlikely to be as well supported by experiments and observations.
High	Cause-and-effect relationships are thoroughly established, generally accepted, and supported by peer-reviewed evidence. The magnitude of species response can be predicted from a given magnitude change in an environmental correlate. The accuracy and precision of the relationship has been statistically evaluated. Contradictory theoretical relationships are unlikely and poorly supported.

The relationships applied in this assessment support the comparison of alternatives based on the available physical and biological information. Specific levels of environmental correlates and criteria used in the assessment of species' responses should not be considered as specific management recommendations or targets for flow, water temperature, or diversion management in Central Valley rivers and the Delta.

Assessment of Change in Spawning Habitat Quantity

Chinook Salmon

The assessment of changes in river flow on Chinook salmon spawning habitat is based on the hypotheses that reduction in spawning habitat will result in reduced fry production. Change in spawning habitat area is assumed to result in a medium level of response—the difference between the proportional spawning habitat area (relative to the maximum available habitat area) for two simulated flow scenarios equals the expected change in survival.

Simulated river flows for 1922–1994 hydrologies are used in the assessment of effects on spawning habitat area. Relative to the base case, a meaningful change in habitat is assumed to occur when the change in river flow equals or exceeds approximately 10%. Average monthly flow is simulated by CALSIM and is used in the assessment of habitat effects. For existing measured flow conditions, daily flows vary by more than 10% from the average monthly flow in the Sacramento, Feather, and American Rivers. Daily variability around the monthly average exceeds 10% even during controlled flow periods (i.e., June–October). During storm events and spring runoff, daily variability around the monthly average has been substantially greater than 10%. The 10% criterion accounts for probable inaccuracies of habitat estimates based on average monthly flow. A change in average flow of less than 10% for a given month would likely not result in a measurable change in spawning habitat area.

Assessment of flow effects is based on the estimated spawning habitat area provided by flows during the spawning and incubation period. Relationships between streamflow and spawning habitat area have been developed from existing instream flow studies (Jones & Stokes 1994). Spawning habitat peaks at about 1,500 to 2,000 cfs on the American River. Change in spawning habitat area in response to flow changes is greatest when flow is less than about 1,000 cfs. For flows higher than 1,000 cfs, changes in flow have little effect on habitat area. Habitat area peaks at about 5,500 cfs in the Sacramento River and at about 500 to 2,500 cfs in the Feather River. Reduced flows that are less than the peak flow and increased flows that are higher than the peak flow both reduce spawning habitat area. For the purpose of this assessment, variation in flows that are greater than the peak flow (i.e., the flow that provides the maximum habitat area) is assumed to have minimal effect and is not included in the assessment of effects on spawning habitat.

Spawning habitat area is the minimum area that is provided by flow during the month of spawning and during subsequent months of incubation. Chinook salmon fry are assumed to emerge from the redd after 3 months of incubation. Therefore, flows during three consecutive months are considered in the calculation of spawning habitat area for Chinook salmon. The assumed occurrence of spawning each month is based on the timing shown in Table 6.1-2.

The certainty of the assessment is low to medium. Evidence from existing research supports the relationship for cause and effect, but the magnitude of species response cannot reliably be predicted from a given magnitude change in spawning habitat area. Fish may use only small sections of the total area that appears suitable relative to gravel quality and flow depth and velocity. Superimposition of redds may be unpredictable. The proportion of spawning habitat used is not available; therefore, the assessment of effects on spawning habitat area assumes that all of the available spawning habitat is potentially used. The potential for redd superimposition is not considered.

High quality spawning habitat, including high quality spawning riffles and gravel, are more important than the “total area” used in this analysis. Flows can be used as a baseline to predict spawning and post-spawning success, but additional habitat measurements such as depth, velocity, spawning gravel quality, and water temperature are necessary for successful spawning and incubation. Burner (1951 in Healey 1991; Bjornn and Reiser 1991) observed Chinook salmon spawning in water as shallow as 0.16 feet (5 cm), Vronski (1972 in Healey 1991) found Chinook salmon spawning in water depths of 23.6 feet (720 cm). Thompson (1972 in Bjornn and Reiser 1991), who also studied water depth requirements for spawning, found Chinook salmon spawning in depths less than 0.8 foot (24 cm).

Flow velocity also affects spawning gravel selection; however, the range in water depth and velocity is very broad (Healey 1991). Literature values for water velocity range from 0.98 to 6.2 feet/sec (30 to 189 cm/s). Studies in northern California found that Chinook salmon from the Yuba and Sacramento Rivers preferred velocities ranging from 1.55 to 2.95 feet/sec (0.47 to 0.9 m/sec) and 0.9 to 2.7 feet/sec (0.27 to 0.8 m/sec), respectively (California Department of Fish and Game 1991c).

Generally, Chinook salmon require substrate that range in size from approximately 0.12 inch to 5.9 inches (0.3 cm to 15 cm) while steelhead prefer substrate no larger than 3.9 inches (10 cm) (Bjornn and Reiser 1991). Spawning habitat quality is correlated with gravel size and intra-gravel flow. Low intra-gravel flow may provide insufficient DO, contribute to growth of fungus and bacteria, and result in high levels of metabolic waste. High percentage of fines in gravel substrates can substantially limit intra-gravel flow, affecting the amount of spawning gravel available in the river (Healey 1991). Raleigh et al. (1986) concluded that optimal gravel conditions would include less than 5 to 10% fine sediments measuring 0.12 inch (0.3 cm) or less in diameter. In addition, alevins of Chinook salmon, steelhead, and coho salmon have been observed to have difficulty emerging in laboratory studies when gravels exceeded 30 to 40% fine sediments (Bjornn 1968; Phillips et al. 1975 in Bjornn and Reiser 1991; Waters 1995).

The assessment assumes saturation of the spawning habitat. Spawning habitat needs for different species and runs using the same stream may vary substantially. Needs also vary from year to year and, depending on the abundance of spawning adults, may vary by orders of magnitude. For example, the current abundance of winter-run Chinook salmon is substantially less than the abundance of fall-run Chinook salmon; therefore, the spawning habitat need is substantially less than it is for fall-run. However, fewer spawning reaches support winter-run spawning. Therefore, the relationship may reflect possible effects. More detailed evaluation of the magnitude of effects and other aspects of the relationships is warranted.

Steelhead

The assessment of changes in river flow on steelhead spawning habitat is based on the hypotheses that reduction in spawning habitat will result in reduced fry production. Change in spawning habitat area is assumed to result in a medium level of response—a change in spawning habitat area results in a proportional change in fry abundance. The assessment of river flow effects on steelhead spawning habitat area is the same as applied to Chinook salmon. Spawning habitat area is the minimum area that is provided by flow during the month of spawning and during subsequent months of incubation. Steelhead fry are assumed to emerge from the redd after 2 months of incubation. Therefore, flows during two consecutive months are considered in the calculation of spawning habitat area for steelhead. The assumed occurrence of spawning each month is based on the timing shown in Table 6.1-2.

The certainty of the assessment relationship is low, primarily because specific data on steelhead spawning in the Sacramento, Feather, and American Rivers are not extensive. Also, the magnitude of species response is weakly supported. It is possible that spawning habitat is not limiting and that the assessment overstates the habitat need. Adequate flows for spawning and incubation have been defined in previous years within different rivers. Flows can be used as a baseline to predict spawning and post-spawning success, but additional habitat measurements such as depth, velocity, spawning gravel quality, and water temperature are necessary for successful spawning and incubation. Flow-habitat relationships for steelhead are also substantially different from the relationships for Chinook salmon because substrate, depth, and velocity preferences differ. As with Chinook salmon, the relationships assume saturation of the spawning habitat. More detailed evaluation of the magnitude of effects and other aspects of the relationships is warranted.

Delta Smelt

The assessment of changes Delta inflow on delta smelt spawning habitat is based on the hypotheses that reduction in spawning habitat will result in reduced larval production. Implementation of the SDIP is unlikely to substantially affect environmental conditions (i.e., fresh water) that maintain the existing habitat area in the Delta. The extent of salinity intrusion into the Delta, as represented by the change in location of X2, will be evaluated to confirm minimal effect on spawning habitat area.

The certainty of the assessment relationship is minimal. Existing information does not indicate that spawning habitat is limiting. Very little is known about spawning habitat needs of delta smelt; therefore, the assumption that spawning habitat is not limiting is speculative. Spawning occurs in fresh water, based on collection of ripe females and larval catches. In drier years, most female and larval delta smelt have been found in the Sacramento River near Prospect Island and the Barker-Lindsey–Cache Slough complex (Wang and Brown 1993). In high outflow years, smelt are found in most of the Delta, Suisun Marsh, and the Napa River (Sweetnam 1999). In addition to poor understanding of spawning location, the primary spawning substrate in the Delta is unknown. Eggs are adhesive, and suitable substrate may be aquatic vegetation, rocks, or instream woody material (Moyle 2002).

Splittail

The assessment is based on the hypothesis that inundation of floodplain and bypasses during high flow years is needed to maintain population abundance. Change in spawning habitat area is assumed to result in a medium level of response—a change in spawning habitat area results in a proportional change in fry abundance.

Spawning habitat availability is dependent on inundation of floodplain and flood bypasses during January through April. The assessment is based on Sacramento River flow conditions that inundate the Sutter and Yolo Bypasses, the primary spawning areas for splittail. The Sutter Bypass is substantially inundated when Sacramento River flow near Colusa is greater than 25,000 cfs. The Yolo Bypass is substantially inundated when Sacramento River flow at Verona is greater than 65,000 cfs. Any reduction in the annual occurrence of flows that are greater than 25,000 cfs at Colusa and 65,000 cfs at Verona or reduction in duration of inundation periods lasting 4 to 8 weeks is considered to have an adverse effect. For simulated average monthly flow, inundation flows were assumed to be 14,000 cfs at Colusa and 40,000 at Verona. Lower flow volumes were used because the simulated monthly flows do not capture inundation that occurs in response to daily or weekly flow variation. Sacramento River flows that are reduced below 14,000 cfs at Colusa and 40,000 cfs at Verona are assumed to result in very large changes in habitat area and substantially affect spawning success. Loss of spawning conditions in any one year is assumed to adversely affect population abundance.

The certainty of the assessment relationship is medium to high based on the historical response of splittail populations to bypass flooding. A significant positive relationship exists between splittail year-class strength and Sacramento River outflow during the spawning season (Daniels and Moyle 1983; Meng and Moyle 1995; Sommer et al. 1997). Spawning has generally been reported to begin in late February or early March, with peaks in late March and April (Baxter et al. 1996) in flooded shallow areas with flowing water (Moyle et al. 2001). Adult splittail forage and spawn among a variety of vegetation types that includes trees, brush, and herbaceous vegetation. Splittail use a number of habitats for spawning, including vegetated tidal slough and Delta channel edges, inundated floodplain, and possibly vegetated edges of riverine pools and backwaters. Inundated floodplain appears to provide the best conditions for successful spawning. Splittail are believed to spawn in open areas less than 4.9 feet (1.5 meters) deep covered with dense annual vegetation, where water temperature does not exceed about 60.8°F (16ºC) (Moyle et al. 2001), and salinity ranges from 0 to 10 ppt. Adults remain in the flooded areas until spawning is completed or water depth and temperatures trigger movement. The highest population levels are seen during wet years and when floodplain is inundated for an extended period of time. Evidence from both the Yolo Bypass and the Cosumnes floodplain suggests that strong year classes of splittail develop mainly in years when floodplains are inundated continuously during March and April (Sommer et al. 1997; Moyle et al. 2001). Two major conclusions are that the population is dominated by year classes produced in wet years and that the timing and duration of floodplain inundation in these years are key factors in determining the strength of these year classes. Variation in year-class strength appears to be controlled primarily by the extent to which floodplain habitat is available for spawning and early rearing. A positive relationship between days of bypass inundation and abundance of age-0 splittail indicates that the largest year classes are produced when floodplain habitat is available for a month or more. The positive relationship with inundation is likely related to the period needed for successful adult immigration and spawning, egg incubation, and emigration of larvae (Sommer et al. 1997).

In dry years, young splittail have been captured in the Sacramento River (Baxter 2003), indicating that spawning may occur along the river margin. Splittail may also spawn in the Yolo Bypass in dry years, using areas inundated by flow from

Cache and Putah Creeks and flow from the Colusa Basin Drain (Sommer et al. 2002). The response to inundation is highest in wet years.

Striped Bass

Spawning habitat in the Delta may be limiting during drier years (California Department of Fish and Game 1992). Delta outflow maintains the spawning habitat area within the Delta. The extent of salinity intrusion into the Delta (i.e., change in location of X2) will be evaluated to determine the potential effect on spawning habitat area.

The certainty of the assessment relationship is low, primarily because the magnitude of the species response (i.e., spawning success) to reduced freshwater area in the lower Delta is unknown. Spawning is dependent on three factors: temperature, flow, and salinity (Clark and Pearson 1978). During high flow years, spawning takes place in the Sacramento River starting above Colusa and extends to below the mouth of the Feather River. In low-flow years, spawning occurs in the Sacramento River from Isleton to Butte City and the San Joaquin River channel in the Delta from Venice Island to Antioch (Moyle 2002).

Green Sturgeon

No assessment was done comparing spawning habitat availability and flow due to lack of information about flow, velocity, and other spawning criteria for green sturgeon. However, river reaches used by green sturgeon for spawning are known to overlap with those used by spawning Chinook salmon and steelhead. However, unlike salmonids, which use relatively shallow habitats for spawning, green sturgeon spawn in deep pools (Moyle et al. 1992b). The assessment of river flow effects on green sturgeon spawning habitat area is assumed to be encompassed by the assessment applied to Chinook salmon. This assessment approach is reasonable because green sturgeon are known to spawn at much greater water depths than Chinook salmon, and green sturgeon spawning habitat area is less likely to be affected by changes in river flow that affect spawning habitat area for Chinook salmon, which have more narrowly defined hydraulic requirements. The certainty of the assessment relationship is low, primarily because the magnitude of the species response (i.e., spawning success) to reduced flow in the rivers is unknown.

Rearing Habitat Quantity

Chinook Salmon

The assessment of changes in river flow on Chinook salmon rearing habitat is based on the hypotheses that reduction in rearing habitat will result in reduced juvenile production. Change in rearing habitat area is assumed to result in a medium level of response—a change in rearing habitat area results in a proportional change in juvenile abundance.

Rearing habitat area tends to reach maximum abundance at very low flows that inundate most of the river channel area and at very high flows that inundate floodplain. Under low-flow (i.e., in-bank) conditions, rearing habitat area declines in response to increased average velocity as flow increases. The reduction in habitat area with increasing flow results from the preference of low velocity areas by juvenile Chinook salmon fry. The relationship may be misleading because the flow-habitat relationship may not adequately reflect local habitat conditions (i.e., availability of low velocity) or the importance of flow-related habitat quality elements (e.g., water temperature conditions or cover and prey availability). The analysis of potential effects on rearing habitat area relies on the assessment of changes to low-flow conditions (e.g., flows less than the 25th percentile during critical and dry year types). Although an actual 10% change in flow may have measurable effects depending on river form, change in simulated monthly average flow of low magnitude (i.e., a flow that is less than the 25th percentile) that exceeds 10% is assumed to affect rearing habitat area. Average monthly flow is simulated by CALSIM and is used in the assessment of habitat effects. For existing measured flow conditions, daily flows vary by more than 10% from the average monthly flow in the Sacramento, Feather, and American Rivers. Daily variability around the monthly average exceeds 10% even during controlled flow periods (i.e., June–October). During storm events and spring runoff, daily variability around the monthly average has been substantially greater than 10%. The 10% criterion accounts for probable inaccuracies of habitat estimates based on average monthly flow. A change in average monthly flow of less than 10% would likely not result in a measurable change in rearing habitat area.

Increased low magnitude flow is assumed to be beneficial, and reduced low magnitude flow is assumed to be detrimental. The proportional change in flow is assumed to result in the same proportional change in juvenile abundance. The proportion of the rearing period affected and the timing change relative to the rearing period are considered in the assessment of the annual effect. The assumed occurrence of rearing each month is based on Table 6.1-2.

The rearing habitat relationship for floodplain is assumed to be similar to the relationship described for splittail spawning. Rearing habitat availability is dependent on inundation of floodplain and flood bypasses during November through April. The Sutter and Yolo Bypasses are primary rearing areas and are dependent on relatively high flows for inundation. Any reduction in simulated monthly average flows that exceed 14,000 cfs at Colusa and 40,000 cfs at Verona is considered to have an adverse effect. Although change in rearing habitat area would likely result in a low level of response, Sacramento River flows that are reduced below 14,000 cfs at Colusa and 40,000 cfs at Verona are assumed to result in relatively large changes in habitat area and may substantially affect rearing success.

The certainty of the assessment relationship for in-channel habitat is low because the relationship of flow to rearing habitat area and the species response to flow-related changes in rearing habitat area is unknown. The certainty of the assessment relationship for inundated floodplain habitat is low to medium, reflecting the documented potential benefits to rearing juvenile Chinook salmon. Recent studies have shown that juvenile salmon have higher growth rates when using floodplains as rearing habitat. Use of floodplain habitat by juvenile

Chinook salmon has been well documented (Jones & Stokes 1993, 1999; California Department of Water Resources 1999b; Sommer and Nobriga et al. 2001). Sommer and Nobriga et al. 2001 found that floodplain habitat provides better rearing and migration habitat for juvenile Chinook salmon than the main river channel. The apparent growth rate of Chinook salmon in the Yolo Bypass ranged from 0.02 to 0.03 inch (0.55 to 0.80 mm) per day, while growth rates in the main channel of the Sacramento River ranged from 0.19 to 0.02 inch (0.43 to 0.52 mm) per day. The faster growth rate in the Yolo Bypass may be attributed to increased prey consumption associated with greater availability of drift invertebrates and warmer water temperature.

In addition to floodplain availability, other environmental conditions such as flow, depth, velocity, and water temperature affect the growth and survivability of juveniles. In rivers, increases in flow provide edge habitat where terrestrial vegetation on the channel edge increases the diversity of habitat conditions. These areas are more productive and increase growth in juvenile fish. Deeper inundation provides more overhead cover and protection from avian and terrestrial predators than shallow water (Everest and Chapman 1972 in Jackson 1992). In broad, low-gradient rivers, change in flow can greatly increase or decrease the lateral area available to juvenile Chinook salmon, particularly in riffles and shallow glides (Jackson 1992).

The quality of the habitat is more critical to survival than the gross area. Caution should be exercised with the assessment because the effect of the flow on habitat is very site-specific within different reaches of the same river. While flows are important for providing additional habitat, other environmental factors such as depth, velocity, and water temperature affect rearing and growth. Although juvenile Chinook salmon do not appear to prefer a particular depth (Jackson 1992), Brett (1952 in Jackson 1992) reported water depths from 1 to 4 feet (0.3 to 1.2 m) as optimal for rearing. Raleigh et al. (1986) reported preferred water depth ranging from 0.5 to 3.0 feet (0.15 to 0.9 m). Water velocity is a particularly important factor in determining where juvenile salmonids occur because it determines the energy requirements for maintaining position and the amount of food delivered to a particular location. Juvenile salmonids tend to select positions that maximize energy gain, but these positions can be altered by interaction with other fish and the presence of cover (Shirvell 1990). Preferred water velocity used by Chinook salmon varies with size. Larger fish occupy higher velocity and deeper areas than small fish, potentially gaining access to abundant food and avoiding predatory birds (Bjornn and Reiser 1991; Jackson 1992). The mean water column velocity preferred by juvenile Chinook salmon is between 0.3 and 1.5 feet/sec (0.09 and 0.46 m/sec).

Steelhead

The assessment of changes in river flow on steelhead rearing habitat is based on the hypotheses that reduction in rearing habitat will result in reduced juvenile production. Change in rearing habitat area is assumed to result in a medium level of response—a change in rearing habitat area results in a proportional change in juvenile abundance. The assessment of changes in river flow on steelhead rearing habitat is the same as described for Chinook salmon for low-flow conditions. Steelhead have not been observed to substantially use inundated floodplain; therefore, the analysis of floodplain inundation applied to Chinook salmon is not applied to steelhead.

The certainty of the assessment relationship is minimal because of limited information on rearing habitat, growth, and survival. Environmental conditions such as depth, velocity, cover, and water temperature affect the growth and survivability of juveniles. Small juvenile steelhead prefer relatively shallow areas. These include pool tailouts characterized by cobble and boulder bottoms or riffles less than 24 inches (0.6 m) deep (Flosi et al. 1998). Larger juveniles live in higher-velocity water although they may prefer areas with low bottom velocity (Hillman and Chapman 1989). There has been conflicting evidence that shows juvenile steelhead use of instream woody material. Several studies (Hillman and Chapman 1989; Baltz et al. 1999) found that juveniles were rarely associated with woody cover. Shirvell (1990) and Swales et al. (1986) found that instream woody material was an important habitat component. Generally, cover provides protection from predators, rest from high currents, and sources of food.

Change in river flow may decrease the quantity of rearing habitat but may not decrease the quality. Using the same flow model used for Chinook salmon will detect changes in flow, but not the change in habitat quality. Because steelhead rearing habitat is not as well-defined as for Chinook salmon, comparisons may not be appropriate.

Delta Smelt

The assessment is based on the hypothesis that rearing habitat area is a function of Delta outflow and that juvenile production is affected by changes in rearing habitat area. Delta outflow may affect estuarine rearing habitat for delta smelt and other estuarine species (Moyle et al. 1992a). The location of X2 (i.e., the approximate location of the 2 ppt isohaline relative to the Golden Gate Bridge) can be used to estimate the estuarine habitat area within the preferred salinity range for a species (Unger 1994). The estimated salinity preference for delta smelt during estuarine rearing is assumed to range from 0.3 ppt to 1.8 ppt. The range represents the 10^{th} and 90^{th} percentiles of the salinity over which delta smelt are distributed.

The geographic location of the upstream and downstream limits of estuarine rearing habitat for delta smelt is computed from X2 that was calculated from average monthly Delta outflow as simulated by the CALSIM model. Monosmith (1993) showed that when X2 is known, the average position of other salinity gradients can be estimated. The position of the 0.3 ppt isohaline equals 0.35 x X2, and the position of the 1.8 ppt isohaline equals 0.74 x X2. The constants were computed with a nonlinear regression model (Unger 1994).

The estuarine rearing habitat area is the surface area between the location of the upper and lower preferred salinity isohalines (Unger 1994). Surface area was used as an index of habitat because habitat surface area is positively correlated with habitat volume. The shore-to-shore surface area was estimated for each kilometer segment of the estuary from the Golden Gate Bridge to the Delta.

Total surface area between the upper and lower salinity preference is the sum of all segments between the estimated locations of the isohalines.

For Alternative 1 (the No Action Alternative) and the action alternatives, the habitat areas computed for each month were divided by the maximum habitat area for Alternative 1, 1922–1994 simulation. The resulting proportional habitat area for a month under Alternative 1 was subtracted from the proportional habitat area for an action alternative for the same month. The difference is the percent change in estuarine rearing habitat area. The percent change in estuarine rearing habitat area is assumed to represent the expected change in survival.

The certainty of the assessment relationship is low, primarily because the magnitude of species response is weakly supported. Rearing habitat is important in Suisun Bay, and when low salinity water is covering shoal areas, these areas are more productive and favorable than deep channel areas (Moyle et al. 1992a). Delta smelt are more abundant in northern Suisun Bay than in the deeper ship channel to the south. While these studies indicate that shoal areas are better rearing grounds for smelt, more detailed evaluation of the magnitude of effects and other aspects of the relationships is warranted.

Splittail

The assessment is based on the hypothesis that rearing habitat area is a function of inundated floodplain and that juvenile production is dependent on rearing habitat area. The assessment is the same as described for adult splittail under spawning habitat quantity.

The certainty of the assessment relationship is medium to high. Variation in year-class strength appears to be controlled primarily by the extent to which floodplain habitat is available for spawning and early rearing. A positive relationship between days of bypass inundation and abundance of age-0 splittail indicates that the largest year classes are produced when floodplain habitat is available for a month or more (Sommer et al. 1997). Seasonally flooded habitat provides abundant food and minimizes predation losses because of the temporary availability of the habitat, relatively shallow depths, turbid waters, and dense cover provided by flooded vegetation. Juvenile and larvae splittail survival and growth improve with abundant and high quality food sources in the floodplain (Moyle et al. 2001). Floodplains are more productive than the main channel of rivers because these broad and shallow vegetated areas are richer in nutrients than deeper and narrower river channels (Sommer and Harrell et al. 2001).

Striped Bass

The assessment is based on the hypothesis that rearing habitat area is a function of Delta outflow and that juvenile production is affected by changes in rearing habitat area. The assessment is the same as described for delta smelt except that the estimated salinity preference for striped bass during estuarine rearing is assumed to range from 0.1 ppt to 2.5 ppt. The range represents the 10^{th} and 90^{th} percentiles of the salinity over which larval and early juvenile striped bass are distributed. The position of the 0.1 ppt isohaline equals 0.11 x X2 and the position of the 2.5 ppt isohaline equals 0.82 x X2. The constants were computed with a nonlinear regression model (Unger 1994).

The certainty of the assessment is low to medium because of conflicting data on survival of larval striped bass and the importance of estuarine rearing habitat. High flows seem to be key in determining survival of young bass, and higher survival is seen at higher outflow (California Department of Fish and Game 1992). The embryos and larvae of striped bass are planktonic and high flows may facilitate movement to appropriate rearing habitat. Growth and survival of larval fish are highest in brackish water because of reduced energy costs for osmoregulation (Moyle 2002). Existing data are confounded by potential relationships between rearing habitat area, transport flows, SWP and CVP pumping, and other interrelated factors.

Green Sturgeon

The assessment is based on the hypothesis that rearing habitat area is a function of area of inundated benthic habitat and that juvenile production is affected by changes in rearing habitat area. The assessment is assumed to be encompassed by that described for Chinook salmon except that the area of rearing habitat is limited to the channel bottom and does not include floodplain or channel bank areas as it is for Chinook salmon. This assessment approach is reasonable because juvenile green sturgeon in the Delta are benthic feeders (Radtke 1966); therefore, rearing habitat area is primarily a function of inundated channel bottom area, rather than total channel area (i.e., channel bottom, channel bank, and floodplain habitat). The certainty of the assessment is low because little is known about the rearing requirements of juvenile green sturgeon and the relationship between flow and quality of estuarine rearing habitat.

Migration Habitat Conditions

Chinook Salmon

Flows that occur in Central Valley rivers generally support migration of adult and juvenile Chinook salmon. Migration habitat conditions that are related to river flows are not assessed.

The assessment of adult migration in the lower San Joaquin River considers project effects on DO. The hypothesis is that low DO conditions in the San Joaquin River channel near Stockton block migration of fall-run Chinook salmon returning to the San Joaquin River basin. The expected effects of the project on flow and subsequent effects on DO levels are used to determine potential blockage of adult Chinook salmon. DO levels less than 5 mg/l are assumed to block upstream migration of Chinook salmon in the San Joaquin River near Stockton. The effect of blockage on the population is relative to the proportion of the adult migration affected during October through November and the expected delay. San Joaquin River flows between 1,000 cfs and 10,000 cfs appear to provide possibilities for managing DO in the San Joaquin River near Stockton.

DO-level effects on adult Chinook salmon are well established, and delay decreases the spawning success through effects on fecundity and survival. At water temperatures greater than 50°F (10°C), Chinook salmon require levels of DO greater than 5 mg/l. Optimum DO is 12 mg/l (Raleigh et al. 1986). Hallock (1970) observed that Chinook salmon avoided water temperatures greater than 66°F if DO was less than 5 mg/l. The certainty of the assessment relationship is low because water temperature and DO levels are interrelated and it is not clear that DO levels alone have blocked migration of adult Chinook salmon in the San Joaquin River near Stockton.

The assessment of juvenile Chinook salmon migration through the Delta focuses on Delta channel pathways and effects on survival of juvenile Chinook salmon. The hypothesis is that alternative migration pathways have different effects on juvenile Chinook salmon survival from the Sacramento and San Joaquin Rivers. Juvenile Chinook salmon are assumed to move in proportion to flow; therefore, an increase in the proportion of flow diverted off the Sacramento River through the DCC and Georgiana Slough would be expected to increase movement of juvenile Chinook salmon into the DCC and Georgiana Slough. The proportion of Sacramento River flow diverted into the DCC and Georgiana Slough is calculated from the simulated flow for the Sacramento River at Freeport and for the DCC and Georgiana Slough. The simulated proportion of juvenile Chinook salmon that move into the DCC and Georgiana Slough is assumed equal to the simulated proportion of flow diverted into the DCC and Georgiana Slough. Survival is greater for fish that remain in the Sacramento River channel (Newman and Rice 1997; Brandes and McLain 2001).

The certainty of the assessment relationship is medium to high for juvenile Chinook salmon in the Sacramento River. Juvenile Chinook salmon survival is lower for fish migrating through the central Delta (i.e., diverted into the DCC and Georgiana Slough) than for fish continuing down the Sacramento River (Newman and Rice 1997).

An increase in the proportion of flow diverted off the San Joaquin River and into Old River would be expected to increase movement of juvenile Chinook salmon into Old River. The proportion of San Joaquin River flow diverted into Old River is based on the simulated flow for the San Joaquin River at Vernalis and for Old River. The simulated proportion of juvenile Chinook salmon that move into Old River is assumed equal to the simulated proportion of flow diverted into Old River. Survival appears to be greater for juvenile Chinook salmon that remain in the San Joaquin River, although the difference in survival for the pathways has not proved to be statistically different through all years (Brandes and McLain 2001; San Joaquin River Group Authority 2003).

In the San Joaquin River, juvenile Chinook salmon survival appears to be lower for fish migrating into Old River near Mossdale than for fish continuing down the San Joaquin River past Stockton (Brandes and McLain 2001). The certainty of the assessment relationship is low to medium for juvenile Chinook salmon in the San Joaquin River because the survival relationship is not clearly supported in all years by data collected (San Joaquin River Group Authority 2003).

Steelhead

Flows that occur in Central Valley rivers generally support migration of adult and juvenile steelhead. Migration habitat conditions that are related to river flows are not assessed.

The assessment for adult and juvenile steelhead migration through the Delta is similar to the assessment described for adult and juvenile Chinook salmon, taking into account differences in timing and distribution. The certainty of the assessment relationship is low because of lack of information about movement of migrating adult and juvenile steelhead in the Delta. DO levels and migration through the Delta have not been studied specifically for steelhead and may differ from the effect on Chinook salmon.

Delta Smelt

Existing information does not indicate clear relationships between migration habitat conditions and adult, larval, and juvenile survival. Effects of environmental conditions (e.g., net and tidal flow) on adult migration are unknown. The effect of net flow on larval and early juvenile movement and survival is unsupported by available data.

The assessment of larval and juvenile entrainment in CVP and SWP exports is assumed to reflect the potential effect of changes in Delta flow conditions on movement and survival of larvae and early juvenile delta smelt. An additional analysis of flow effects is not applied.

Splittail

Existing information indicates that high flow and the inundation of floodplain initiates upstream adult migration (Garman and Baxter 1999). The assessment of spawning habitat quantity for adult splittail (see Spawning Habitat Quantity) depicts the potential effects on adult, larval, and early juvenile movement onto and off of the floodplain.

Adult migration movements begin sometime between late November and early January and continue into March. Upstream movement is seen when high flow events occur during February–April (Garman and Baxter 1999), but other studies indicate that migration occurs when inundated floodplain habitat is available earlier in the water year. As water levels recede in the floodplain, juvenile splittail return to the main channel and ultimately to tidal areas in response to decreased depth and increasing water temperature (15ºC–18ºC) (Moyle et al. 2001).

Striped Bass

The assessment of larval and juvenile entrainment in CVP and SWP exports is assumed to reflect the potential effect of changes in Delta flow conditions on movement and survival of larvae and early juvenile striped bass. An additional analysis of Delta flow effects is not applied.

Implementation of the SDIP is not expected to substantially affect Sacramento River inflow during striped bass spawning. Sacramento River flow at Freeport will be evaluated to confirm minimal effect on flows less than 11,000 cfs during April and May. The certainty of the assessment relationship is medium because of fairly well–established relationships between flow and movement of eggs and larvae. Available information indicates that low Sacramento River flow (i.e., less than 13,000 cfs at Freeport) may affect survival of striped bass between the egg and 6 mm larvae stage (California Department of Fish and Game 1992). The mechanisms that may reduce survival are: low velocity that results in eggs and larvae settling to the river bottom and ultimately die; delay in reaching higher quality nursery areas; increased exposure to toxic substances; and more exposure to entrainment (CVPIA document).

Green Sturgeon

Flows that occur in the Sacramento River generally support migration of adult and juvenile green sturgeon. Migration habitat conditions that are related to river flows are not assessed.

Water Temperature

Water temperature within the Sacramento–San Joaquin River basin is primarily an issue for coldwater species, including Chinook salmon and steelhead.

Chinook Salmon

The assessment is based on the hypothesis that survival of freshwater life stages (adult migration, spawning and incubation, rearing, and juvenile migration) is dependent on suitable water temperatures in Central Valley rivers. Monthly water temperature effects are estimated for selected locations and all life stages of Chinook salmon. Simulated monthly water temperature indicates the potential direction of effect when considered relative to species water temperature requirements. For the purposes of this impact assessment, survival indices are based on experimental tolerance studies reported in the literature, a use recommended by EPA and Armour (cited in Sullivan et al. 2000; Armour 1991).

Water temperature for the Trinity, Sacramento, Feather, and American Rivers is simulated by Reclamation's temperature model. The model simulates monthly temperature conditions in CVP and SWP reservoirs and at locations downstream from the discharge points, providing estimates of monthly temperature. Model inputs include initial storage and temperature conditions, simulated reservoir storage, simulated model segment inflow, simulated model segment outflow, evaporation, solar radiation, and average air temperature. Release temperatures from reservoirs are computed for each outlet level of the dams. River temperatures are computed for each month at river locations represented by specific model segments. River temperatures are based on the quantity and temperature of the simulated reservoir release, normal climatic conditions, and tributary accretions. During warmer months (March through October), reservoir releases warm with distance downstream.

Temperature survival indices were estimated for Chinook salmon life stages, including adult migration, spawning and incubation, rearing, and smolt migration

(Table 6.1-7). The temperature survival indices are estimated from curves fitted to available survival data. The survival indices applied in this assessment support the comparison of alternatives and should not be considered specific management recommendations or targets for water temperature management in Central Valley rivers.

The certainty of the assessment relationship is high. Water temperature effects on fish are well established and can be used to predict survival. As water temperature increases toward the extremes of the tolerance range of a fish, biological responses, such as impaired growth and risk of disease and predation, are more likely to occur (Myrick and Cech 2001; Sullivan et al. 2000). Acceptable water temperatures identified in the available literature for Chinook salmon and steelhead life stages fall within a relatively broad range. Conclusive studies of the thermal requirements completed for Chinook salmon and steelhead in Central Valley streams are limited (Myrick and Cech 2001). Based on a literature review, conditions supporting adult Chinook salmon migration are assumed to deteriorate as temperature warms between 54ºF and 70ºF (12.2°C and 21.1°C) (Hallock 1970 as cited in McCullough 1999). For Chinook salmon eggs and larvae, survival during incubation is assumed to decline with increasing temperature between 54ºF and 61ºF (12.2°C and 16.1°C) (Myrick and Cech 2001; Seymour 1956 cited in Alderice and Velsen 1978). For juvenile Chinook salmon, survival is assumed to decline as temperature warms from 64ºF to 75ºF (17.8°C to 23.9°C) (Myrick and Cech 2001; Rich 1987). Relative to rearing, Chinook salmon require cooler temperatures to complete the parr-smolt transformation and to maximize their saltwater survival. Successful smolt transformation is assumed to deteriorate at temperatures ranging from 63ºF to 73ºF (17.2°C to 22.8°C) (Marine 1997, cited in Myrick and Cech 2001; Baker et al. 1995). Juveniles are more at risk in the Delta, and water temperatures over the optimal limit increase mortality. Baker et al. (1995) developed a statistical model to estimate the influence of temperature on the survival of Chinook salmon smolts migrating through the Delta. The model estimated that Chinook salmon released at Ryde and migrating to Chipps Island undergo 50% mortality at 71.6ºF-75.2ºF (22ºC to 24ºC).

Table 6.1-7. Monthly Temperature Survival Indices for Chinook Salmon and Steelhead

	Chinook Salmon				Steelhead			
Water Temperature (°F)	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration[1]
50	100%	100%	100%	100%	100%	100%	100%	100%
51	100%	100%	100%	100%	100%	100%	100%	100%
52	100%	100%	100%	100%	100%	100%	100%	100%
53	100%	100%	100%	100%	100%	100%	100%	100%
54	100%	100%	100%	100%	100%	98%	100%	100%
55	100%	99%	100%	100%	100%	91%	100%	100%
56	100%	96%	100%	100%	99%	80%	100%	100%
57	100%	90%	100%	100%	98%	63%	100%	100%
58	99%	82%	100%	100%	96%	37%	100%	100%
59	97%	69%	100%	100%	94%	0%	100%	100%
60	94%	52%	100%	100%	90%	0%	100%	100%
61	91%	29%	100%	100%	87%	0%	100%	100%
62	87%	0%	100%	100%	82%	0%	100%	100%
63	81%	0%	100%	100%	76%	0%	100%	100%
64	74%	0%	100%	100%	69%	0%	100%	100%
65	66%	0%	100%	99%	61%	0%	100%	99%
66	57%	0%	97%	96%	52%	0%	100%	96%
67	46%	0%	93%	92%	42%	0%	98%	92%
68	33%	0%	87%	87%	29%	0%	95%	87%
69	18%	0%	77%	79%	16%	0%	90%	79%
70	0%	0%	65%	69%	0%	0%	83%	69%
71	0%	0%	48%	57%	0%	0%	73%	57%
72	0%	0%	27%	42%	0%	0%	61%	42%
73	0%	0%	0%	23%	0%	0%	45%	23%
74	0%	0%	0%	0%	0%	0%	25%	0%
75	0%	0%	0%	0%	0%	0%	0%	0%

[1] Survival indices for Chinook salmon smolt migration are assumed to apply to steelhead; indices for adult migration, juvenile rearing, and juvenile migration of Chinook salmon are assumed to apply to coho salmon in the Trinity River.

Note: The survival indices in this table support the comparison of alternatives and should not be considered specific management recommendations or targets for water temperature management in Central Valley rivers.

Steelhead

The assessment is based on the hypothesis that survival of freshwater life stages (i.e., adult migration, spawning and incubation, rearing, and juvenile migration) is dependent on suitable water temperatures in Central Valley rivers. The assessment is the same as described for Chinook salmon except that temperature survival indices were estimated for steelhead life stages (Table 6.1-7).

The certainty of the assessment relationship is high. Water temperature effects on fish are well established and can be used to predict survival. For steelhead, successful adult migration and holding are assumed to deteriorate as water temperature warms between 52ºF and 70ºF (11.1°C and 21.1°C). Adult steelhead appear to be much more sensitive to thermal extremes than are juveniles (National Marine Fisheries Service 1996a; McCullough 1999). Conditions supporting steelhead spawning and incubation are assumed to deteriorate as temperature warms between 52ºF and 59ºF (11.1°C and 15°C) (Myrick and Cech 2001). Juvenile rearing success is assumed to deteriorate at water temperatures ranging from 63ºF to 77ºF (17.2°C to 25°C) (Raleigh et al. 1984; Myrick and Cech 2001). Relative to rearing, smolt transformation requires cooler temperatures, and successful transformation occurs at temperatures ranging from 43ºF to 50ºF (6.1°C to 10°C). Juvenile steelhead, however, have been captured at Chipps Island in June and July at water temperatures exceeding 68ºF (Nobriega and Cadrett 2001). Given the movement of steelhead at water temperatures warmer than required for successful smolt transformation, the water temperature criteria applied to migration of steelhead smolt are assumed to be the same as those applied to assess water temperature effects on Chinook salmon smolt migration.

Food

Chinook Salmon

The assessment for Chinook salmon under Rearing Habitat Quantity is assumed to reflect the potential effects on food for juvenile Chinook salmon. The assessment is based on the hypothesis that food production and availability are directly related to inundated channel and floodplain area. The certainty of the assessment relationship is low to medium, primarily because the relationship between river flow and food availability for juvenile Chinook salmon is relatively unknown. Use of floodplain habitat by juvenile Chinook salmon, however, has been well documented (Jones & Stokes 1993, 1999; California Department of Water Resources 1999b; Sommer and Harrell et al. 2001). Sommer and Harrell et al. 2001 found that floodplain habitat provides better rearing and migration habitat for juvenile Chinook salmon than the main river channel. The apparent growth rate of Chinook salmon in the Yolo Bypass ranged from 0.02 to 0.03 inch (0.55 to 0.80 mm) per day, while growth rates in the main channel of the Sacramento River ranged from 0.016 to 0.02 inch (0.43 to 0.52 mm) per day. The faster growth rate in the Yolo Bypass may be attributable to increased prey consumption associated with greater availability of drift invertebrates and warmer water temperature.

Steelhead

The assessment of effects on food for steelhead is the same as described for Chinook salmon for in-channel habitat. Steelhead do not appear to use floodplain habitat as extensively as juvenile Chinook salmon; therefore, assessment of effects on floodplain food sources are not considered. The certainty of the assessment relationship is minimal, primarily because the relationship between river flow and food availability for juvenile steelhead is relatively unknown.

Delta Smelt

The assessment for delta smelt under Rearing Habitat Quantity is assumed to reflect the potential effects on food for juvenile and adult delta smelt in estuarine rearing habitat. The assessment is based on the hypothesis that food production is directly related to the location of X2 in Suisun Bay and that food availability affects smelt survival.

The certainty of the assessment relationship is low to medium, primarily because the magnitude of species response is weakly supported. Rearing habitat in Suisun Bay is assumed to be important to maintaining smelt population abundance. Under similar salinity conditions, shoal areas are more productive and favorable for delta smelt feeding than deep channel areas (Moyle et al. 1992a, 1996). Delta smelt are more abundant in northern Suisun Bay than in the deeper ship channel to the south (Bennett et al. 2002 cited in white paper), and post-larvae are larger and have higher feeding success (Hobbs and Bennett, in preparation cited in white paper). While the studies indicate that shoal areas are better rearing grounds for smelt, more detailed evaluation of the magnitude of effects and other aspects of the relationships is warranted.

Splittail

The assessment for splittail under Spawning Habitat Quantity and Rearing Habitat Quantity is assumed to reflect the potential effects on food for larval, juvenile, and adult splittail. The assessment is based on the hypothesis that effects of food production and availability on splittail abundance are directly related to inundated floodplain area. The certainty of the assessment relationship is medium. Two studies on the Yolo Bypass (Sommer and Harrell et al. 2001) and the Cosumnes River (Moyle, unpublished data) indicate an increase of food resources on floodplain habitat. Also the longer the floodplain is available, the longer juvenile splittail can rear and obtain more food (see Rearing Habitat Quantity).

Striped Bass

The assessment for striped bass under rearing habitat quantity is assumed to reflect the potential effects on food for juvenile bass in estuarine rearing habitat. The assessment is based on the hypothesis that food production is directly related to the location of X2 in Suisun Bay and that food availability affects striped bass survival. The assessment of effects on food for striped bass is the same as described for delta smelt. The certainty of the assessment relationship is medium, primarily because the magnitude of species response is weakly supported.

Green Sturgeon

The assessment for Green Sturgeon under Rearing Habitat Quantity is assumed to reflect the potential effects on food for juvenile green sturgeon. The assessment is based on the hypothesis that food production and availability are directly related to inundated channel bottom area. The certainty of the assessment relationship is low, primarily because the relationship between river flow and food availability for juvenile green sturgeon is relatively unknown.

Entrainment

Entrainment of fish with water diverted from the Delta has been identified as a primary concern for Chinook salmon, delta smelt, and other fish species (U.S. Fish and Wildlife Service 1996). More than 1,800 agricultural, municipal, and industrial diversions have the potential to entrain fish with diverted water. The CVP and SWP pumping plants, the two largest diversions from the Delta, entrain thousands of fish annually. The environmental conditions that influence the number of fish lost to diversions include:

- abundance, distribution, and movement of fish in the Delta;
- diversion location, volume, duration, frequency, and timing (e.g., seasonal, diurnal, tidal phase);
- effects of net and tidal flows on the movement of fish;
- effects of diversions on net and tidal flows;
- direct and indirect (i.e., net and tidal flow) effects of gates on fish movement;
- efficacy of fish salvage (i.e., screening, handling, holding, transport, and release) facilities and procedures; and
- predation vulnerability prior to entrainment and associated with salvage facilities and procedures, including release of salvaged fish near Antioch.

The SDIP includes project actions that potentially affect the number of fish entrained by SWP and CVP pumping and in other diversions. The timing and volume of SWP and CVP pumping is potentially altered with implementation of the SDIP. Construction of gates at the head of Old River and in other south Delta channels potentially blocks fish movement and alters net and tidal flows that could affect the movement and distribution of fish and subsequent entrainment.

Although entrainment is well documented at the SWP and CVP facilities, the relationships between affected environmental conditions, the number of fish entrained, and the potential population effect remain relatively weakly supported. Hypothetical basic relationships for entrainment include:

1. The number of fish entrained is directly related to export volume and an assumed density of fish in the water diverted.

2. The number of fish entrained is related to the interaction between Delta channel hydraulics and fish distribution. Fish are assumed to behave and move as passive particles within the water column.
3. The number of fish entrained is related to the interaction among Delta channel hydraulics, fish distribution, and fish behavior. Fish use hydraulic conditions to expedite movement toward their migration objective.

The three basic hypotheses, potential variability in expected entrainment effects, and the certainty of the assumed entrainment relationships are discussed in detail in Appendix J, "Methods for Assessment of Fish Entrainment in SWP and CVP Exports."

For this impact assessment, entrainment of Delta fishes is based primarily on the first hypothesis that the number of fish entrained is directly related to export volume and an assumed monthly salvage density of fish in the water diverted. Salvage and entrainment loss is assumed to increase linearly with increased exports.

For Chinook salmon, historical loss estimates (i.e., monthly loss per cubic foot per second of pumping) provide the basis for assessing effects of changes in SWP and CVP pumping. DFG has calculated the number of Chinook salmon in each run that are salvaged and lost at the SWP and CVP pumping facilities. The median loss per cubic foot per second for each month, each salmon run, and each facility for 1992–2002 was multiplied by the simulated monthly SWP and CVP pumping rates (cfs) to arrive at total entrainment loss estimates for each year. The total annual entrainment loss for each salmon run for each action alternative was compared to the total annual entrainment loss for the No-Action Alternative.

To provide a context of impact level, entrainment loss was compared to the estimated annual number of juvenile Chinook salmon expected to enter the Delta. Historical juvenile numbers entering the Delta were estimated by the method applied by NOAA Fisheries for winter-run Chinook salmon (Winter-Run JPE [juvenile production estimate] Estimator Program). Juvenile production entering the Delta was estimated for fall-, late fall–, winter-, and spring-run Chinook salmon from the Sacramento and San Joaquin River systems (Appendix J, "Methods for Assessment of Fish Entrainment in SWP and CVP Exports"). The number of juveniles entering the Delta was based on historical escapement (i.e., the estimated number of adult spawners for each run). The number of adult spawners was multiplied times an assumed proportion of females (0.783), number of eggs per female (5,000), survival rate from egg to juvenile (0.1475), and survival of migration to the Delta (0.52).

For all other species (steelhead, delta smelt, splittail, striped bass, and green sturgeon), historical salvage density estimates (i.e., monthly salvage per cfs of pumping) provide the basis for assessing effects of changes in SWP and CVP pumping on entrainment. Annual life-stage production estimates are not available, so the monthly entrainment estimates are not normalized for the relative size and abundance expected in each month. The analysis, therefore, is based on simulated change in salvage that provides an indication of the possible magnitude of change in entrainment loss. The impact on the population is assessed qualitatively based on a range of possible factors (e.g., fish size, fish distribution within and entering the Delta).

DFG has calculated the number of steelhead, delta smelt, splittail, and striped bass that are salvaged at the SWP and CVP pumping facilities. The monthly pattern of salvage numbers and fish size is provided in (Appendix J, "Methods for Assessment of Fish Entrainment in SWP and CVP Exports"). The median salvage density for each month and each facility for 1980–2002 was multiplied by the simulated SWP and CVP monthly pumping rate (cfs) to arrive at total annual salvage values. The total annual salvage for the action alternatives was compared to the total annual salvage for the No-Action Alternative.

Significance Criteria

Assessment species are selected based on listing under the ESA, listing in environmental management plans (e.g., local environmental plans and state resource agency plans), and ecological, economic, or social importance. Under NEPA and CEQA, impacts are considered significant when project actions, viewed with past, current, and reasonably foreseeable future projects, potentially reduce the abundance and distribution of the assessed fish species (Public Resources Code Section 21083; Guidelines Section 15065). Significant impacts may occur through substantial:

- interference with the movement of any resident or migratory fish species;
- long- or short-term loss of habitat quality or quantity;
- adverse effects on rare or endangered species or habitat of the species that affect population abundance or distribution; or
- adverse effects on fish communities or species protected by applicable environmental plans and goals.

Determination of significance requires that the species population abundance and distribution would likely be reduced. Change in survival, growth, reproduction, and movement for any given life stage, however, may not affect the abundance and distribution of a species. Quantifying population level effects is complicated by annual variation in species abundance and distribution in response to variable environmental conditions that may or may not be driven by human activities. In addition, beneficial effects may offset adverse effects for specific aspects of specific life stages, resulting in beneficial or minimal impacts on the overall population.

The significance thresholds under NEPA and CEQA for species population abundance and distribution require maintenance of population resilience and persistence. Resilience is the ability of the species to increase in abundance and distribution in response to improved environmental conditions. Persistence is the ability of the species to sustain itself through periods of adverse environmental conditions. The thresholds include:

- any permanent change in an environmental correlate that would substantially reduce the average abundance of the population over a range of weather-related conditions (e.g., water year types);
- any change in an environmental correlate that would permanently limit the geographic range and the seasonal timing of any life stage; and
- any potential reduction in population abundance, distribution, and production for years with deficient environmental conditions (e.g., water years 1987–1991 or years where weather-related conditions fall below the lowest 20th percentile).

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project-specific actions. The mitigation measures address the short-term, long-term and cumulative effects of the CALFED Bay-Delta Program.

The discussion of significant impacts and mitigation measures in this section will include one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the SDIP. These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to the SDIP resource area are listed below; therefore, numbering may appear out of sequence. To see a full listing of CALFED programmatic mitigation measures, please refer to Appendix E, "Mitigation Measures Adopted in the CALFED Record of Decision."

Fisheries and Aquatic Systems Mitigation Measures

1. Implement BMPs, including a stormwater pollution prevention plan, toxic materials control and spill response plan, and vegetation protection plan.
2. Limit construction activities to windows of minimal species vulnerability.
3. Create additional habitat for desired species, including increased aquatic area and structural diversity through construction of setback levees and channel islands.
5. Operate new and existing diversions to avoid and minimize effects on fish—avoid facility operations during periods of high species vulnerability.
7. Control predators in the diversion facility (screen bays) and modify diversion facility structure and operations to minimize predator habitat.
9. Coordinate and maximize water supply system operations flexibility consistent with seasonal flow and water temperature needs of desired species.

10. Identify and investigate issues regarding beneficial reuse of dredged material, including conducting core sampling and analysis of proposed dredged areas, and implement engineering solutions to avoid or prevent environmental exposure to toxic substances after dredging.
11. Cap exposed toxic sediments with clean clay/silt and protective gravel.
12. Locate constructed shallow-water habitat away from sources of mercury until methods for reducing mercury in water and sediment are implemented.
13. Use cofferdams to construct levees and channel modifications in isolation from existing waterways.
14. Use sediment curtains to contain turbidity plumes during dredging.
15. Schedule ground disturbing construction during the dry season.
16. Follow established and proper procedures and regulations for identifying, removing and disposing of contaminated materials.
17. Utilize the criteria and objectives in the Water Transfer Program, in conjunction with existing legal constraints on water transfers, to protect against adverse effects due to water transfers. The criteria for future water transfer proposals include: Transfers must not harm fish and wildlife resources and their habitats.

Alternative 1 (No Action)

New construction activities would not be implemented under the No Action Alternative. Temporary barriers, however, would continue to be constructed and removed annually in the south Delta channels. The head of Old River fish control barrier and barriers in Middle River, Grant Line Canal, and Old River would be constructed every year as they have been in the past. Construction of the barriers includes grading the channel bank and placement of riprap and other materials on the channel bank and bottom.

Various permit conditions are placed on the Temporary Barriers Program by the USFWS, NOAA Fisheries, and DFG (San Joaquin River Group Authority 2003). The earliest in-water construction activities that can be conducted on the head of Old River, Middle River, and Old River at Tracy barriers during the spring barrier installation period is April 7. Construction of the northern abutment and boat ramps of the Grant Line Canal barrier and construction of out-of-water portions of the head of Old River, Middle River, and Old River at Tracy barriers may not be started before April 1. Full closure of the Grant Line Canal barrier is not required, but construction of the north abutment and boat ramps must be completed to the extent that full barrier closure and operation can be readily achieved in a reasonable time frame when directed by DWR. The permit conditions require that all the above work be completed by April 15, a total of 15 days.

Construction activities remove, disturb, modify, and replace channel bottom and channel bank substrates. Although annual activities are unlikely to remove or disturb substantial aquatic and riparian vegetation, reestablishment of vegetation is prevented within the footprint of the barriers. Organisms on the channel bottom and bank may be removed or crushed during grading and placement of riprap. Local noise, physical movement, and vibration may cause temporary movement of individuals from adjacent habitat.

During barrier construction, there is potential for spill of petroleum products associated with operation of equipment and suspension of sediment. Contaminants, including suspended sediment, may adversely affect organisms within the channel, causing mortality from acute toxicity and suffocation of fish eggs and sessile organisms.

The placement of the barriers on Middle River, Grant Line Canal, and Old River maintains water surface elevation above 1.0 foot msl during May through September. Under current conditions, tides range from about 1.0 foot below mean sea level to 3.0 feet msl two times each day. The placement of the barriers blocks fish access when tidal level is below 1.0 foot msl, although access is maintained when tidal level exceeds 1.0 foot msl (i.e., between 1.0 and 3.0 feet msl). The volume of water exchanged during each tidal cycle (i.e., between the high and the low tidal level) is reduced by about 50% for the channels upstream of the barriers on Middle River, Grant Line Canal, and Old River. Effects on water quality have been monitored but have not been detected. The barriers on Middle River, Grant Line Canal, and Old River may also be in place in April to mid-May and in October and November, although the culverts on the Grant Line Canal barrier are tied open.

The head of Old River fish control barrier minimizes movement of juvenile fall-run Chinook salmon from the San Joaquin River into Old River from about April 14 through June 1. Juvenile Chinook salmon move down the San Joaquin River past Stockton, a pathway believed to enhance survival relative to movement into Old River (Brandes and McLain 2001).

The head of Old River fish control barrier increases flow in the San Joaquin River past Stockton from about September 15 through November 30. The increased flow in the San Joaquin River potentially improves water quality, including increased DO, in the San Joaquin River channel near Stockton (Giulianotti et al. 2003). Improved water quality could benefit upstream migrating adult Chinook salmon.

Alternative 1 does not include any changes to water supply operations. Current reservoir operations, diversions, and SWP and CVP pumping from the Delta would continue. Effects of flow and diversions on fish habitat conditions in the Trinity, Sacramento, Feather, American, and San Joaquin Rivers and the Delta would be the same as under existing water supply operations criteria. Effects of reservoir storage on fish habitat in Trinity, Shasta, Oroville, San Luis, and Folsom Reservoirs would also be the same as under existing water supply operations criteria.

2020 Conditions

Under Future No Action (2020 conditions), the SDIP project components would not be built or operated; diversion and pumping would not increase. SWP and CVP operations would remain the same. It is expected that the temporary barriers program would continue and that other water supply–related projects would be implemented. There would be no impacts on fisheries resources from dredging activities or placement of permanent gates, and existing conditions as described above would continue.

Under 2020 conditions, CALSIM modeling results indicate small changes may occur in the Trinity, American, and Sacramento Rivers. Trinity River flows increase in some months and water temperatures in these months are improved. Upstream Sacramento and American River flows show a tendency to decrease and their temperatures also show a slight increase. The proportion of spawning habitat available under the No Action Alternative for steelhead and Chinook salmon is reduced slightly under 2020 conditions relative to 2001 conditions in the American River (Table 6.1-8 and 6.1-9) and less so in the Sacramento River. Compared to 2001 conditions, base water temperature survival indices for the No Action Alternative under 2020 conditions indicate slightly reduced survival for Chinook salmon (adult migration, juvenile rearing, smolt migration) and steelhead (adult migration, juvenile rearing, smolt migration) in the American River (Table 6.1-23 and 6.1-10). Similarly, base water temperature survival indices for Chinook salmon (spawning/incubation and adult migration) and steelhead (adult migration) in the Sacramento River indicate a slight reduction in survival (Table 6.1-17 and 6.1-11).

Although the CALSIM results for monthly inflows and pumping may be slightly different, the effects of flow and diversions on fish and fish habitat conditions in the Delta would be similar to 2001 conditions. The effects of these simulated 2020 CVP and SWP pumping levels on south Delta tidal hydraulics are similar to the simulated tidal hydraulic conditions for the 2001 conditions. Thus, the effects of the No Action Alternative under 2020 conditions would be similar to the effects described under 2001 conditions, resulting in no significant difference from existing conditions for Chinook salmon, steelhead, delta smelt, splittail, striped bass and green sturgeon in the Delta.

Table 6.1-8. Frequency of Monthly Spawning Habitat Availability for Steelhead and Chinook Salmon in the Sacramento, Feather, and American Rivers for Alternative 1, 1922–1994 Simulation

Proportion of Spawning Habitat Available (%)	Fall-Run Chinook Salmon	Late Fall–Run Chinook Salmon	Winter-Run Chinook Salmon	Spring-Run Chinook Salmon	Steelhead
Feather River					
<+100%	219			219	365
<+90%	0			0	0
<+80%	0			0	0
<+70%	0			0	0
<+60%	0			0	0
<+50%	0			0	0
<+40%	0			0	0
<+30%	0			0	0
<+20%	0			0	0
<+10%	0			0	0
0%	0			0	0
Sacramento River at Keswick					
<+100%	212	212	290	213	356
<+90%	7	7	2	6	9
<+80%	0	0	0	0	0
<+70%	0	0	0	0	0
<+60%	0	0	0	0	0
<+50%	0	0	0	0	0
<+40%	0	0	0	0	0
<+30%	0	0	0	0	0
<+20%	0	0	0	0	0
<+10%	0	0	0	0	0
0%	0	0	0	0	0
American River at Nimbus					
<+100%	163				292
<+90%	14				32
<+80%	8				8
<+70%	22				23
<+60%	3				4
<+50%	9				3
<+40%	0				0
<+30%	0				3
<+20%	0				0
<+10%	0				0
0%	0				0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-9. Frequency of Monthly Spawning Habitat Availability for Steelhead and Chinook Salmon in the Sacramento, Feather, and American Rivers for Alternative 1, 1922–1994 Simulation (2020 Operations)

Proportion of Spawning Habitat Available (%)	Fall-Run Chinook Salmon	Late Fall–Run Chinook Salmon	Winter-Run Chinook Salmon	Spring-Run Chinook Salmon	Steelhead
Feather River					
<+100%	219			219	365
<+90%	0			0	0
<+80%	0			0	0
<+70%	0			0	0
<+60%	0			0	0
<+50%	0			0	0
<+40%	0			0	0
<+30%	0			0	0
<+20%	0			0	0
<+10%	0			0	0
0%	0			0	0
Sacramento River at Keswick					
<+100%	208	209	292	214	352
<+90%	11	10	0	5	13
<+80%	0	0	0	0	0
<+70%	0	0	0	0	0
<+60%	0	0	0	0	0
<+50%	0	0	0	0	0
<+40%	0	0	0	0	0
<+30%	0	0	0	0	0
<+20%	0	0	0	0	0
<+10%	0	0	0	0	0
0%	0	0	0	0	0
American River at Nimbus					
<+100%	143				273
<+90%	17				26
<+80%	11				11
<+70%	27				30
<+60%	8				10
<+50%	12				11
<+40%	1				1
<+30%	0				3
<+20%	0				0
<+10%	0				0
0%	0				0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-10. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the American River at Sunrise for Alternative 1, 1922–1993 Simulation (2020 Operations)

	Fall-Run Chinook Salmon				Steelhead			
Base Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
1.0	169	303	406	174	360	278	732	390
0.9	34	34	22	26	54	28	119	26
0.8	3	27	4	11	8	8	9	11
0.7	28	14	0	5	6	8	0	5
0.6	52	7	0	0	40	7	2	0
0.5	35	9	0	0	14	5	1	0
0.4	30	5	0	0	10	4	0	0
0.3	33	4	0	0	7	4	1	0
0.2	17	7	0	0	1	4	0	0
0.1	13	0	0	0	2	4	0	0
0.0	18	22	0	0	2	154	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Alternative 2A

Stage 1 (Physical/Structural Component)

Construction of the gates under Alternative 2A potentially affects environmental conditions in the south Delta (Table 6.1-12). Permanent gates would be constructed at the head of Old River and in Middle River, Grant Line Canal, and Old River at DMC. Construction of the gates includes grading the channel bank, dredging the channel bottom, constructing sheet-pile cofferdams or an in–the-wet construction method, and placing riprap, concrete, and other materials on the channel bank and bottom.

Dredging for all of the permanent gates would occur between August and November (Chapter 2, “Project Description”). Cofferdams would also be placed in the channel during the August through November timeframe. Work outside of the channel and within the cofferdams, if used, is assumed to occur during any month.

The construction activities would remove, disturb, modify, and replace channel bottom and channel bank substrates. Aquatic and riparian vegetation would be removed within the footprint of the gate and the footprint of riprap along the contiguous levee face and channel bottom. Organisms on the channel bottom and bank would be removed or crushed during grading, dredging, and placement of riprap and other materials. The cofferdams, if used, would isolate the work area for gate construction from the channel. Water and associated fish and other aquatic organisms would be pumped out of the isolated area and into the Delta channel. Local noise, physical movement, and vibration generated during construction may temporarily cause individuals to move out of adjacent habitat.

During gate construction, there is potential for spill of petroleum products and suspension of sediments associated with operation of equipment (Table 6.1-12). Using a cofferdam to isolate work on the gate structure would minimize suspended sediment and the potential introduction of contaminants into the channel. If cofferdams are not used, other methods, such as sediment curtains, would be implemented to minimize suspension of fine sediment. Contaminants introduced into the channel, including suspended sediment, may adversely affect organisms, causing mortality from acute toxicity and suffocation of fish eggs and sessile organisms.

In addition to the dredging associated with gate construction, conveyance dredging is proposed in West Canal, Old River, Middle River, and Grant Line Canal (Table 6.1-12). Dredging may also be required to accommodate operation of the intakes for some existing agricultural diversions that would be extended to a greater water depth. Maintenance dredging may be required at an unspecified interval to maintain channel capacity and the function of the gates. Some level of maintenance dredging could occur every year, and approximately 25% of the area initially dredged would be dredged every 5 years. Dredging would remove and disturb the channel bottom. Aquatic vegetation would be removed within the footprint of the dredging. Organisms on the channel bottom would be removed. Local noise, physical movement, and vibration generated by the dredge may temporarily cause individuals to move out of adjacent habitat. Spill of petroleum products and suspension of sediment may occur during dredge operation. Contaminants introduced into the channel, including suspended sediment, may adversely affect organisms, causing mortality from acute toxicity and suffocation of fish eggs and sessile organisms.

Dredging would increase the conveyance capacity of the channel. Tidal flow velocity may be slightly reduced in West Canal and, depending on existing channel constrictions, circulation may be increased in Middle River, Old River, and Grant Line Canal (Section 5.2, Delta Tidal Hydraulics).

Extending the 24 agricultural intakes is not expected to increase the exposure of fish to entrainment. The environmental effects of extending the intakes were summarized in the BO issued by NOAA Fisheries on dredging around or extending the intakes (National Marine Fisheries Service, Southwest Region 2003). The BO concluded that modifying the diversions would not allow for any additional water to be diverted that would exceed that which has been historically diverted through the current diversions. The conservation measures described in the BO will ensure that adverse impacts to fish are avoided.

The operation of the permanent flow control gates on Middle River, Grant Line Canal, and Old River would maintain water surface elevation above 0.0 feet msl during April 15 through November or other periods as determined by USFWS, NOAA Fisheries, and DFG (Table 6.1-12; Section 5.2, Delta Tidal Hydraulics). Under current conditions, tides range from about 1.0 foot below mean sea level

Table 6.1-11. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Sacramento River at Red Bluff for Alternative 1, 1922–1993 Simulation (2020 Operations)

	Fall-Run Chinook Salmon				Fall-/Late Fall–Run Chinook Salmon				Winter-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Base Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
1.0	388	397	432	216	532	486	859	648	573	146	715	504	469	211	859	576	468	328	859	432
0.9	23	18	0	0	23	67	5	0	3	170	5	0	15	73	5	0	21	74	5	0
0.8	7	2	0	0	7	6	0	0	0	52	0	0	6	23	0	0	7	34	0	0
0.7	1	1	0	0	1	1	0	0	0	19	0	0	1	8	0	0	0	30	0	0
0.6	5	2	0	0	5	2	0	0	0	10	0	0	5	8	0	0	3	15	0	0
0.5	1	3	0	0	1	4	0	0	0	8	0	0	1	8	0	0	3	5	0	0
0.4	3	1	0	0	3	2	0	0	0	2	0	0	3	2	0	0	1	8	0	0
0.3	2	1	0	0	2	1	0	0	0	3	0	0	2	2	0	0	0	3	0	0
0.2	2	1	0	0	2	1	0	0	0	0	0	0	2	1	0	0	1	2	0	0
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0	0	6	0	0	0	6	0	0	0	22	0	0	0	24	0	0	0	5	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-12. Potential Actions, Impact Mechanisms, and Affected Environmental Conditions with Implementation of the South Delta Improvements Project

Project Actions	Impact Mechanisms Associated with Implementing Project Actions	Affected Environmental Conditions
Construct operable gates on Middle River, Grant Line Canal, and Old River and a fish control structure at the head of Old River	Grade channel bank and dredge channel bottom: ▪ Head of Old River—500 feet ▪ Old River—540 feet ▪ Middle River—200 feet ▪ Grant Line Canal—600 feet Construct bottom-hinged gates, boat locks, and supporting structures across the channel. Place rip rap on channel bank and bottom: ▪ Head of Old River—11,000 square feet ▪ Old River—49,000 square feet ▪ Middle River—11,000 square feet ▪ Grant Line Canal—15,400 square feet Construct 1,000 feet of new setback levee on Old River, leave part of existing levee as channel island. Construct sheet-pile coffer dams to isolate construction areas; pump water from inside of coffer dams. Potential accidental spill of petroleum products. Traffic noise and footprint disturbance.	Substrate: remove, disturb, modify, and replace channel bottom and channel bank substrates. Cover: Remove and disturb aquatic and riparian vegetation; add hard structure to the channel cross section. Contaminants: potential spill of petroleum products and concrete; suspend sediment during dredging, grading, and other construction activities. Channel dimensions: change channel depth and width. Non-native predator species: change in cover, depth, and velocity associated with the gate structure may alter habitat for non-native species. Physical contact: remove or crush organisms during dredging, grading, placement of rip rap; entrain organisms with water pumped during evacuation of construction areas within coffer dams. Disturbance: noise, physical movement, or vibration sufficient to cause movement of individuals from local habitat.

Project Actions	Impact Mechanisms Associated with Implementing Project Actions	Affected Environmental Conditions
Operate gates on Middle River, Grant Line Canal, and Old River and a fish control structure at the head of Old River	Operate the gates (i.e., Middle River, Grant Line Canal, and Old River) to maintain a minimum level above 0.0 feet mean sea level during May through September. Operate the head of Old River gate to minimize movement of juvenile fall-run Chinook salmon from the San Joaquin River into Old River from April 1 to May 31. Operate the head of Old River gate to increase flow in the San Joaquin River past Stockton during September 15–November 30.	Gate: the closure of the bottom-hinged gates at the head of Old River will block flow and fish movement; closure of the bottom-hinged gates at other gates will block flow and fish movement during levels less than 0.0 feet mean sea level. Level: operation of the gate will maintain level at 0.0 feet mean sea level in the channels on the upstream side of the gates and potentially reduce inter-tidal area. Flow velocity: operation of the gate will affect circulation in the channels on the upstream and downstream side of the gates. Net flow direction: depending on interaction between inflow and diversions, net flow direction may change in some channels. Soil moisture: higher level could increase soil moisture elevation on lands adjacent to the affected channels. Cover: change in level could affect maintenance and establishment of riparian and aquatic vegetation, affecting the availability of cover. Contaminants: change circulation may change residence time and volume and the concentration of salts, pesticides, nutrients, and other materials from agricultural return flows. Water temperature: change in circulation could change water temperature. Dissolved oxygen: change in circulation could change dissolved oxygen levels. Predator effectiveness: the operation of the gates could potentially create feeding areas for predator species and hydraulic conditions that disorient prey. Non-native predator species: change in cover, depth, and velocity may alter habitat to favor non-native species in the channels between gates. Food: change in residence time, in combination with change in contaminants, may affect food production.

Project Actions	Impact Mechanisms Associated with Implementing Project Actions	Affected Environmental Conditions
Dredge West Canal, Old River, Middle River, and Grant Line Canal	Grade and remove vegetation to create staging area for dredge machinery and operation. Remove and disturb channel bottom and channel bank substrate and vegetation (i.e., aquatic and riparian) along: ▪ West Canal—Clifton Court Forebay intake to Victoria Canal ▪ Middle River—MR 49 to MR 12 ▪ Old River—spot dredging at specific siphons Divert water for conveyance of dredged sediments (i.e., depends on dredge type). Potential for accidental spill of petroleum products into the channel. Change channel conveyance capacity. Disturb and bury terrestrial or aquatic communities at dredge disposal sites and along routes to disposal sites. Discharge of dredge conveyance water. Traffic noise and footprint disturbance.	Channel dimensions: increase channel depth and width; potential for ongoing changes to channel dimensions and potential loss of existing shallow area. Substrate: remove, disturb, and mobilize channel bottom and channel bank substrates; potential for ongoing erosion of shallow areas from changes in channel dimensions. Cover: remove or disturb aquatic and riparian vegetation; potential for ongoing loss of riparian and aquatic vegetation from channel bank erosion. Contaminants: petroleum products from construction equipment; suspended sediment from construction activities; mobilized contaminants from channel sediments. Level: change in channel dimensions may affect level. Flow velocity: change in velocity from the change in channel dimensions. Non-native predator species: change in cover, depth, and velocity may alter species habitat. Physical contact: removal or crushing of organisms during dredging and disposal of dredge spoils.

Table 6.1-12. Continued

Project Actions	Impact Mechanisms Associated with Implementing Project Actions	Affected Environmental Conditions
Maintenance dredging in and around gates and agricultural pumps and siphons	Remove and disturb channel bottom and channel bank substrate and vegetation (i.e., aquatic and riparian) at gates, siphons, and pumps in Old River, Middle River, and Grant Line Canal. Divert water for conveyance of dredged sediments (i.e., depends on dredge type). Potential for accidental spill of petroleum products into the channel. Maintain channel conveyance capacity. Disturb and bury terrestrial or aquatic communities at dredge disposal sites and along routes to disposal sites. Discharge of dredge conveyance water. Traffic noise and footprint disturbance.	Channel dimensions: maintain channel depth and width; potential loss of shallow area. Substrate: remove, disturb, and mobilize channel bottom and channel bank substrates; potential for ongoing erosion of shallow areas from changes in channel dimensions. Cover: remove or disturb aquatic and riparian vegetation; potential for ongoing loss of riparian and aquatic vegetation from channel bank erosion. Contaminants: petroleum products from construction equipment; suspended sediment from construction activities; mobilized contaminants from channel sediments. Flow velocity: change in velocity from the change in channel dimensions. Non-native predator species: change in cover, depth, and velocity may alter species habitat. Physical contact: removal or crushing of organisms during dredging and disposal of dredge spoils.
Extend agricultural diversions on Middle River, Grant Line Canal, and Old River	Potential for increased duration and depth of diversion. Disturb channel bottom and bank substrate. Potential accidental spill of petroleum products during construction activities.	Substrate: disturb channel substrates. Cover: remove or disturb aquatic and riparian vegetation at siphon or pump. Contaminants: petroleum products from construction equipment; suspended sediment from construction activities. Physical contact: entrainment of fish and other aquatic organisms in deeper diversion.

Project Actions	Impact Mechanisms Associated with Implementing Project Actions	Affected Environmental Conditions
Increase State Water Project Delta diversions	Change in upstream reservoir operations. Change in Delta exports. Change in the use of exported water (i.e., effects on agricultural practices, wildlife refuge operations, etc.).	Reservoir shallow water area: operations may change the seasonal level of reservoirs. Flow level: river level could change in response to changes in reservoir releases. Depth: river depth would change with level. Flow velocity: river velocity would change with river level; net Delta channel velocity could respond to river inflow changes and export changes. Net flow direction: change in net Delta channel flow direction would respond to river inflow changes and export changes. Floodplain inundation: dependent on change in river level. Soil moisture: dependent on change in river level. Diversion: Delta exports would increase in response to changes in Delta operations criteria and upstream reservoir operations; upstream diversions may also change. Substrate: could be affected depending on the magnitude of river flow change related to spill. Cover: could be affected depending on the magnitude, duration, timing, and frequency of change in level and effects on riparian vegetation. Water temperature: operations may affect reservoir storage volume and river flow, subsequently affecting river water temperature Salinity: dependent on changes in Delta outflow in response to Delta inflow and exports. Turbidity: could be affected by river inflow, Delta exports, changes in nutrient input and production. Predator effectiveness: could be affected by change in turbidity. Outside food input: could be affected depending on the magnitude of river flow change. Food production: dependent on change in residence time and losses to diversion.

to 3.0 feet msl two times each day. The maximum change in SWP pumping (and CCF operations) could reduce the daily higher high tide from about 2.6 to 2.4 feet msl near the CCF gates (Section 5.2, Delta Tidal Hydraulics; Figures 5.2-60 through 5.2-62). The reduction in higher high tide attributable to change in SWP pumping is less with distance from the CCF gates. When closed during tide levels below 0.0 feet msl, the flow control gates block fish passage. When opened during tide levels greater than 0.0 feet msl, fish passage is restored. The volume of water exchanged during each tidal cycle is reduced by about 20% for the channels upstream of the gates on Middle River, Grant Line Canal, and Old River.

During the spring, the head of Old River fish control gate would be operated to block flow and movement of juvenile fall-run Chinook salmon and other fishes from the San Joaquin River into Old River from about April 1 through June 1, or other periods as recommended by USFWS, NOAA Fisheries, and DFG (Table 6.1-12). Juvenile Chinook salmon move down the San Joaquin River past Stockton, a pathway believed to enhance survival relative to movement into Old River (Brandes and McLain 2001).

During fall, the head of Old River fish control gate would be operated to increase flow in the San Joaquin River past Stockton from about September 15 through November 30 or other periods as recommended by USFWS, NOAA Fisheries, and DFG. The increased flow in the San Joaquin River potentially improves water quality, including increased DO, in the San Joaquin River channel near Stockton (Giulianotti et al. 2003). Improved water quality could benefit upstream migrating adult Chinook salmon.

Chinook Salmon

The following assessment identifies potential construction-related impacts of implementing Alternative 2A on winter-, spring-, and fall-/late fall–run Chinook salmon in Central Valley rivers and the Delta. The assessment also identifies the impacts on Chinook salmon as a result of operating the gates. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages for each run.

Impact Fish-1: Construction-Related Loss of Rearing Habitat Area for Chinook Salmon. Chinook salmon rear in the Delta. Construction of the gates in the south Delta and maintenance activities have the potential to permanently modify shallow vegetated areas that may provide rearing habitat for Chinook salmon. The area of shallow vegetated habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, "Project Description," and Section 5.6, Sediment Transport).

The permanent gates constructed under Alternative 2A would have minimal effect on habitat within the construction footprint at the head of Old River, Middle River, and Old River at DMC. Construction of the temporary barriers has previously modified shallow water habitat. These permanent gates would be constructed in the same location as the temporary barriers and would result in little change in habitat quality and quantity relative to Alternative 1.

Construction of a new gate on Grant Line Canal, which would be located in a different location than the temporary barrier, and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing shallow vegetated habitat. Although the loss of shallow vegetated habitat in the Delta has not been explicitly identified as a factor contributing to the decline of Chinook salmon (U.S. Fish and Wildlife Service 1996), juvenile Chinook salmon are known to rear in the south Delta and use shallow vegetated areas (Feyrer 2001; Grimaldo et al. 2000).

Relative to historical extent, existing availability of shallow vegetated areas is limited. Therefore loss of additional shallow vegetated area that may represent rearing habitat for Chinook salmon could contribute to the historical loss and to an ongoing adverse impact.

The relative importance of specific areas and habitat types to growth and survival of juvenile Chinook salmon is currently unknown. Areas colonized by nonnative aquatic vegetation (e.g., *Egeria densa)* may not provide habitat for juvenile Chinook salmon (Grimaldo et al. 2000). Nonnative species currently dominate the fish community in shallow vegetated areas of the south Delta (Feyrer 2001), and many of the species prey on juvenile Chinook salmon. In addition, current efforts such as the temporary barrier at the head of Old River, focus on routing juvenile Chinook salmon down the San Joaquin River past Stockton and away from the south Delta channels. Available data indicate that survival is lower for juvenile Chinook salmon that are drawn off the San Joaquin River into Old River, although statistical differences between the survival relationships are not always significant (San Joaquin River Group Authority 2003). Low survival is attributable to entrainment in diversions, especially CVP and SWP pumping.

Rearing habitat loss associated with gate construction, maintenance activities, and dredging is determined to be less than significant. The determination is based on:

- the area disturbed by construction of gates on Middle River, Old River at DMC, and the head of Old River would be similar to the existing footprint of the temporary barriers;
- the footprint of the gate on Grant Line Canal would be in a new location, but the absence of the temporary barrier footprint would reestablish a similar area of rearing habitat;
- dredging would increase channel depth, but habitat area would remain unchanged and habitat quality would be similar (i.e., shallow water [the resulting bottom elevation is less than 3 m below mean lower low water (MLLW)]) following recolonization of the temporarily disturbed substrate by the affected benthic organisms (see Impact Fish-2); and
- implementation of a dredge monitoring program to confirm minimal effects of dredging on rearing habitat (see Chapter 2, “Project Description”).

No mitigation is required.

Impact Fish-2: Construction-Related Reduction in Food Availability for Chinook Salmon. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for juvenile Chinook salmon. Construction of the gates in the south Delta and maintenance activities have the potential to permanently modify shallow vegetated areas and remove bottom substrates that may produce food for Chinook salmon. The area of prey habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, "Project Description," and Section 5.6, Sediment Transport).

The permanent gates constructed under Alternative 2A would have minimal effect on prey habitat within the construction footprint at the head of Old River, Middle River, and Old River at DMC. Construction of the temporary barriers has previously modified shallow water areas and channel bottom substrates. The permanent gates would be constructed in the same location as the temporary barriers and would result in little change in prey habitat quality and quantity relative to Alternative 1.

Construction of a new gate on Grant Line Canal and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing shallow vegetated areas and channel bottom substrate. Prey habitat loss associated with gate construction, riprap, maintenance activities, and dredging is determined to be less than significant. The determination is based on the small area affected by gate construction and riprap placement relative to availability of similar vegetated areas and bottom substrates in adjacent channel reaches. Also, benthic invertebrates are expected, based on changes in benthic invertebrate abundance observed in response to changes in salinity (Markham 1986; Vayssieres and Peterson 2003), to recolonize bottom substrates disturbed by dredging relatively quickly. For reasons similar to those discussed for Impact Fish-1, construction would have a minimal effect on prey availability, especially over the long term. No mitigation is required.

Impact Fish-3: Construction-Related Loss of Chinook Salmon to Accidental Spill of Contaminants. Contaminants associated with construction activities, including gate construction, placement of riprap, dredging, and maintenance dredging, could be accidentally introduced into the south Delta channels and could adversely affect Chinook salmon and their habitat. 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, "Project Description"). The environmental commitments would eliminate the likelihood of any substantial contaminant input. Contaminants would have a less-than-significant impact on Chinook salmon and their habitat in the south Delta because the potential for increased contaminant input following implementation of environmental commitments is small. No mitigation is required.

Impact Fish-4: Construction-Related Loss of Chinook Salmon to Direct Injury. Construction of the gates would include placement of sheetpiles and riprap and could directly injure fish present during the time of construction. Dredging could entrain and injure juvenile Chinook salmon. Cofferdams, if used, would be installed to isolate gate construction areas from the channel. Placement of cofferdams in the channels could trap juvenile Chinook salmon. Fish that become trapped inside the cofferdams could be killed during desiccation of the construction area and construction activities. Direct injury associated with construction and maintenance activities, including dredging, would have a less-than-significant impact on Chinook salmon because the number of fish injured is likely small given that:

- in-water construction, including the construction of a cofferdam, would occur between August and November;
- the area of construction activity is small relative to the channel area providing similar habitat quality in the south Delta;
- in-water construction and dredging would occur over a relatively short period (i.e., about 3 years); and
- most juvenile and adult Chinook salmon would move away from construction activities and into adjacent habitat of similar quality.

No mitigation is required.

Impact Fish-5: Construction-Related Loss of Chinook Salmon to Predation. Construction of gates and extension of agricultural intakes would add permanent structure and cover to the south Delta channels. The presence of natural or artificial cover (e.g., pilings, piers, trees, or aquatic plants) in rivers is known to attract relatively higher concentrations of fish than are present in areas without cover (Johnson and Stein 1979). Cover can disrupt flow patterns and provide fish with refuge from elevated water velocity (Shirvell 1990). Food may also be more abundant in areas with cover (Johnson et al. 1988). The addition of structure has the potential to increase the density of predator species and predation on fish moving around and past the structure.

Juvenile Chinook salmon and other fish species are known to be vulnerable to predators at locations such as RBDD, CCF, and release sites for fish salvaged from the SWP and CVP facilities (Hall 1980; Pickard et al. 1982; Bureau of Reclamation 1983). These facilities and release sites create relatively high concentrations of juvenile salmonids and other fish species that may be substantially disoriented by turbulence and handling associated with diversion, flow constriction, bypasses, and salvage. Concentrations of disoriented fish increase prey availability and create predator habitat.

Predation associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels could cause a small and likely negligible (i.e., less-than-significant impact) increase in mortality of the juvenile Chinook salmon moving past the structures. The determination is based on several factors. Design elements will minimize turbulence that could disorient fish and increase vulnerability to predation. The structures would not create conditions that could concentrate juvenile Chinook salmon. Flow velocity would be similar to velocities within the channel upstream and downstream of the gates and agricultural intake extensions.

The transition zones between various elements of the gates (e.g., sheetpiles and riprap) could provide low-velocity holding areas for predatory fish. Predatory fish holding near the gates and agricultural intakes could prey on vulnerable species. The additional predator habitat created by the gates and intake extensions would have a less-than-significant impact on juvenile Chinook salmon because the increase in potential predator habitat is small relative to habitat in adjacent areas, including the habitat currently created by the temporary barriers and habitat at the existing agricultural intakes. Disorientation and concentration of juvenile fish would be minimal given the size and design of the gates. This impact is less than significant. No mitigation is required.

Impact Fish-6: Effects of Gate Operation on Juvenile and Adult Chinook Salmon Migration. The head of Old River fish control gate could be closed from April 14 to May 15 under Alternative 1 and closed from April 1 to May 31 under Alternative 2A (i.e., when San Joaquin River flow is less than 10,000 cfs) (Table 6.1-12). Under Alternative 1 (No Action), a temporary fixed barrier is constructed each year. Under Alternative 2A, a gate would be constructed with operable gates that would allow a range of operations. Gate closure would minimize the movement of juvenile Chinook salmon into Old River. Although the effects of gate closure are similar for both Alternatives 1 and 2A, the operable gate constructed under Alternative 2A would provide increased opportunities (i.e., longer closure) for fish protection. The increased flexibility to operate the fish control gate is also considered a beneficial impact.

The head of Old River fish control gate may also provide benefits to adult Chinook salmon during upstream migration in September, October, November, and other months (Table 6.1-12). Hallock (1970) observed that adult Chinook salmon avoided water temperatures greater than 66°F if DO was less than 5 mg/l. Low DO in the San Joaquin River channel near Stockton may delay migration of fall-run Chinook salmon. High San Joaquin River flows past Stockton maintain higher DO levels (Hayes and Lee 2000). Closure of the head of Old River fish control gate increases the San Joaquin River flow past Stockton, but the increase in flow during years with low-to-average flow (less than 1,000 cfs) appears to have minimal effect on DO levels. Available data indicate that the operation of flow control gates could reduce DO in the San Joaquin River near Stockton during the summer, but closure of the head of Old River fish control gate September 15 through November 30 would result in DO levels that are the same for Alternatives 1 and 2A (Section 5.3, Water Quality; Figure 5.3-44). Migration of adult Chinook salmon would be protected. Although the benefit of closing the head of Old River fish control gate to upstream movement of adult fall-run Chinook salmon is uncertain for all flow conditions, an operable gate constructed under Alternative 2A would provide increased opportunities to evaluate the potential effects of increased flow under a wide range of San Joaquin River flow conditions (Table 6.1-12). The increased flexibility of an operable gate is a beneficial impact.

Gates in Middle River, Grant Line Canal, and Old River near Byron could affect access to rearing habitat in the south Delta channels and passage through the channels by adult and juvenile Chinook salmon during operation from April 15 through November and other months as needed (Table 6.1-12). Operation of the gates, however, generally avoids the period of adult and juvenile Chinook salmon movement through the Delta, except during May and June when juvenile Chinook salmon could be affected. During May, the proposed closure of the head of Old River Gate would transcend the effects of the gates on Middle River, Grant Line Canal, and Old River near Byron. In addition, the gate operations would have a beneficial effect relative to the existing temporary barriers. The existing temporary barriers are in place from mid-May through September and may also be in place in April to mid-May and in October and November, although the culverts on the Grant Line Canal barrier are tied open. Tidal flow overtops the barriers twice each day during the portion of tide that exceeds 1 foot msl. High tide approaches 3 feet msl, and total tidal volume in the channels upstream of the barriers is reduced by about 50% (Section 5.2, Delta Tidal Hydraulics). The gates constructed under Alternative 2A would operate from May through September. The gates would be open at tide elevations between 0.0 feet msl and about 3 feet msl, an increase in the tidal period currently allowed by the temporary barriers. Total tidal volume would approach 80% of the tidal volume without gates in place. Operable gates would have a beneficial impact on movement of adult and juvenile Chinook salmon because of the potential management flexibility and increased period of access to Middle River, Grant Line Canal, and Old River (i.e., passage conditions are provided at water surface elevations exceeding 0 feet msl under Alternatives 2A–2C versus passage provided at elevations exceeding 1 foot msl under Alternative 1). The increased flexibility of an operable gate is a beneficial impact.

Impact Fish-7: Effects of Head of Old River Gate Operation on Juvenile Chinook Salmon Entrainment. Closure of the head of Old River fish control gate during April–May under Alternative 2A would direct juvenile Chinook salmon down the San Joaquin River during most of the peak out-migration period. Installation of the temporary barrier reduces the number of juvenile Chinook salmon salvaged compared to years when the temporary barrier was not installed (San Joaquin River Group Authority 2003). Although the difference in the estimated survival with and without the gate is not statistically significant, relative survival for juvenile Chinook salmon migrating down the San Joaquin River has been about twice the survival for Chinook salmon migrating down Old River (Brandes and McLain 2001; Baker and Morhardt 2001).

Whether or not the gate alone would substantially minimize entrainment-related losses of juvenile fall-run Chinook salmon from the San Joaquin River, however, is currently not well supported. The gate closure results in additional flow from the San Joaquin River channel into Turner Cut, Middle River, and Old River channels to supply the CVP and SWP pumps. There is currently no clear correlation between SWP and CVP pumping and survival of juvenile Chinook salmon moving through the Delta in the lower San Joaquin River (Baker and Morhardt 2001).

Steelhead

The following assessment identifies potential construction-related impacts of implementing Alternative 2A on Central Valley steelhead. The assessment also identifies the impacts on steelhead as a result of operating the gates. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages.

Impact Fish-8: Construction-Related Loss of Rearing Habitat Area for Steelhead. Steelhead rear primarily in natal reaches upstream of the Delta; therefore, construction activities in the Delta would not affect steelhead rearing. This potential impact is less than significant. No mitigation is required.

Impact Fish-9: Construction-Related Reduction in Food Availability for Steelhead. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for steelhead. Steelhead are not expected to rear for substantial periods in the Delta. Construction activities in the Delta would, therefore, not be expected to affect food resources for steelhead. This potential impact is less than significant. No mitigation is required.

Impact Fish-10: Construction-Related Loss of Steelhead to Accidental Spill of Contaminants. Contaminants associated with construction activities, including gate construction, placement of riprap, dredging, and maintenance dredging, could be introduced into the south Delta channels and could adversely affect steelhead during migration. 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, “Project Description”). The environmental commitments would substantially reduce the likelihood of any considerable contaminant input. Contaminants would have a less-than-significant impact on steelhead moving through the south Delta because the potential for increased contaminant input following implementation of environmental commitments is small. No mitigation is required.

Impact Fish-11: Construction-Related Loss of Steelhead to Direct Injury. Construction of the gates would include placement of sheetpiles and riprap and could directly injure fish present during the time of construction. Dredging could entrain and injure juvenile steelhead. Cofferdams, if used, would be installed to isolate gate construction areas from the channel. Placement of cofferdams in the channels could trap juvenile steelhead. Fish that become trapped inside the cofferdams could be killed during desiccation of the construction area and other construction activities. Direct injury associated with construction and maintenance activities, including dredging, would have a less-than-significant impact on steelhead because the number of fish injured is likely small given that:

- in-water construction, including the construction of a cofferdam, would occur between August and November;
- the area of construction activity is small relative to the channel area providing passage through the south Delta;
- in-water construction and dredging would occur over a relatively short period (i.e., about 3 years); and
- most juvenile and adult steelhead would move away from construction activities and into adjacent habitat of similar quality.

No mitigation is required.

Impact Fish-12: Construction-Related Loss of Steelhead to Predation. Construction of gates and extension of agricultural intakes would add permanent structure and cover to the south Delta channels. The addition of structure has the potential to increase the density of predator species and predation on fish moving around and past the structure. Similar to Chinook salmon, predation associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels could cause a small and likely negligible (i.e., less-than-significant impact) increase in mortality of the juvenile steelhead moving past the structures. The determination is based on the same factors described for juvenile Chinook salmon (Impact Fish-7). No mitigation is required.

Impact Fish-13: Effects of Head of Old River Gate Operation on Juvenile Steelhead Migration. Closure of the head of Old River fish control gate would minimize the movement of juvenile steelhead into Old River. Although the effects of gate closure are similar for both Alternatives 1 and 2A, an operable gate constructed under Alternative 2A would provide increased opportunities for fish protection in response to new information on fish survival for variable flows and migration pathways. The increased flexibility is a beneficial impact.

The head of Old River fish control gate may also provide benefits to adult steelhead during upstream migration in September through March. The benefits would be similar to those described above for adult Chinook salmon relative to movement in the San Joaquin River past Stockton (Impact Fish-7). An operable gate constructed under Alternative 2A would provide increased opportunities to evaluate the potential effects of increased flow and effects on DO levels under a wide range of San Joaquin River flow conditions. The increased flexibility of an operable gate is a beneficial impact.

Delta Smelt

The following assessment identifies potential construction-related impacts of implementing Alternative 2A on delta smelt. The assessment also identifies the impacts on delta smelt as a result of operating the gates. Delta smelt occur primarily within the Delta and Suisun Bay. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages.

Impact Fish-14: Construction-Related Loss of Spawning Habitat Area for Delta Smelt. Delta smelt spawn in the Delta. As indicated in the methods description, existing information does not indicate that spawning habitat is limiting population abundance and production (U.S. Fish and Wildlife Service 1996).

Shallow areas that may provide spawning habitat for delta smelt could be permanently modified by construction of the gates in the south Delta and subsequent maintenance activities. The area of shallow habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, "Project Description," and Section 5.6, Sediment Transport). The permanent gates constructed under Alternative 2A would have minimal effect on habitat within the construction footprint at the head of Old River, Middle River, and Old River at DMC. Construction of the temporary barriers has previously modified shallow water habitat. These permanent gates would be constructed in the same location as the temporary barriers and would result in little change in habitat quality and quantity relative.

Construction of a new gate on Grant Line Canal and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing shallow habitat. The loss of spawning habitat in the Delta has not been explicitly identified as a factor contributing to the decline of delta smelt, and the south Delta channels have not been identified as important spawning habitat (U.S. Fish and Wildlife Service 1996). The relative importance of spawning habitat in the south Delta in contributing to population abundance is likely low. Nonnative species currently dominate the fish community in shallow areas of the south Delta (Feyrer 2001), and many of the species prey on delta smelt and their eggs. In addition, entrainment of larvae in diversions, especially CVP and SWP pumping, would minimize the importance of spawning habitat in the south Delta.

Spawning habitat loss associated with gate construction, maintenance activities, and dredging is determined to be less than significant. The determination is based on:

- the area disturbed by construction of gates on Middle River, Old River at DMC, and the head of Old River would be similar to the existing footprint of the temporary barriers;
- the footprint of the gate on Grant Line Canal would be in a new location, but the absence of the temporary barrier footprint would reestablish a similar area of potential spawning habitat;
- dredging would increase channel depth, but habitat area would remain unchanged and habitat quality would be similar (i.e., shallow water [the resulting bottom elevation is less than 3 m below MLLW]) following the temporary disturbance of substrate; and

- implementation of a dredge monitoring program to confirm minimal effects of dredging on spawning habitat (see Chapter 2, "Project Description").

No mitigation is required.

Impact Fish-15: Construction-Related Loss of Rearing Habitat Area for Delta Smelt. Delta smelt larvae, juveniles, and adults rear in the Delta and Suisun Bay. The importance of rearing habitat in the south Delta, however, appears to be relatively low. Nonnative species currently dominate the fish community in the south Delta (Feyrer 2001), and many of the species prey on delta smelt larvae and juveniles. In addition, entrainment of larvae and juveniles in diversions, especially CVP and SWP pumping, would minimize the importance of rearing habitat in the south Delta.

Rearing habitat loss associated with gate construction, maintenance activities, and dredging is determined to be less than significant. The determination is based on:

- the area disturbed by construction of gates on Middle River, Old River at DMC, and the head of Old River would be similar to the existing footprint of the temporary barriers;
- the footprint of the gate on Grant Line Canal would be in a new location, but the absence of the temporary barrier footprint would reestablish a similar area of rearing habitat;
- dredging would increase channel depth, but habitat area would remain unchanged and habitat quality would be similar (i.e., shallow water; [the resulting bottom elevation is less than 3 m below MLLW]) following the temporary disturbance of substrate; and
- implementation of a dredge monitoring program to confirm minimal effects of dredging on rearing habitat (see Chapter 2, "Project Description").

No mitigation is required.

Impact Fish-16: Construction-Related Reduction in Food Availability for Delta Smelt. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for delta smelt. Construction of the gates in the south Delta and maintenance activities have the potential to permanently modify channel form and remove bottom substrates. Delta smelt, however, feed on zooplankton and effects on benthic invertebrate habitat may not affect food for delta smelt. This potential impact is less than significant for the same reasons discussed for effects on rearing habitat (see Impact Fish-15). No mitigation is required.

Impact Fish-17: Construction-Related Loss of Delta Smelt to Accidental Spill of Contaminants. Contaminants associated with construction activities, including gate construction, placement of riprap, dredging, and maintenance dredging, could be introduced into the south Delta channels and could adversely affect delta smelt and their habitat. 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, "Project Description"). The environmental commitments would substantially reduce the likelihood of any considerable contaminant input. Contaminants would have a less-than-significant impact on delta smelt and their habitat in the south Delta because the potential for increased contaminant input following implementation of environmental commitments is small. No mitigation is required.

Impact Fish-18: Construction-Related Loss of Delta Smelt to Direct Injury. Construction of the gates would include placement of sheetpiles and riprap and could directly injure fish present during the time of construction. Dredging could entrain and injure delta smelt. Cofferdams, if used, would be installed to isolate gate construction areas from the channel. Placement of cofferdams in the channels could trap larval, juvenile, and adult delta smelt. Fish that become trapped inside the cofferdams could be killed during desiccation of the construction area and construction activities. Direct injury associated with construction and maintenance activities, including dredging, would have a less-than-significant impact on delta smelt because the number of fish injured is likely small given that:

- in-water construction, including the construction of a cofferdam, would occur between August and November;
- the area of construction activity is small relative to the channel area providing similar habitat quality in the south Delta; and
- most juvenile and adult delta smelt would move away from construction activities and into adjacent habitat of similar quality.

No mitigation is required.

Impact Fish-19: Construction-Related Loss of Delta Smelt to Predation. Construction of gates and extension of agricultural intakes would add permanent structure and cover to the south Delta channels. As indicated for Chinook salmon (Impact Fish-5), the addition of structure has the potential to increase the density of predator species and predation on fish moving around and past the structure. Concentrations of disoriented fish increase prey availability and create predator habitat.

Predation associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels could cause a small and likely negligible (i.e., less-than-significant impact) increase in mortality of the delta smelt moving past the structures. The determination is based on several factors. Design elements will minimize turbulence that could disorient fish and increase vulnerability to predation. The structures would not create conditions that could concentrate delta smelt. Flow velocity would be similar to velocities within the channel upstream and downstream of the gates and the agricultural intake extensions.

The transition zones between various elements of the gates (e.g., sheetpiles and riprap) could provide low-velocity holding areas for predatory fish. Predatory fish holding near the gates and agricultural intakes could prey on vulnerable species. The additional predator habitat created by the gates and intake extensions would have a less-than-significant impact on delta smelt because the increase in potential predator habitat is small relative to habitat in adjacent areas, including the habitat currently created by the temporary barriers and habitat at the existing agricultural intakes. Disorientation and concentration of juvenile and adult fish would be minimal given the size and design of the gates. No mitigation is required.

Impact Fish-20: Effects of Gate Operation on Delta Smelt Spawning and Rearing Habitat, and Entrainment. Under constant SWP and CVP pumping, gate closure causes additional net flow to be drawn from the San Joaquin River and south through Old River, Middle River, and Turner Cut (Section 5.2, Delta Tidal Hydraulics). The increased net flow toward the south may increase entrainment of larval and juvenile delta smelt (see the following section on Entrainment). The effects of gate closure are similar for Alternatives 1 and 2A, however the fish control gate constructed under Alternative 2A would be operated for all of April and May.

Flow control gates in Middle River, Grant Line Canal, and Old River at DMC could affect access to spawning and rearing habitat for delta smelt in the south Delta channels. The gates constructed under Alternative 2A would be open at tide elevations between 0.0 feet msl and about 3 feet msl, an increase in the tidal range currently allowed by the temporary barriers. Total tidal volume would approach 80% of the tidal volume that would occur without gates in place. The flow control gates could have a beneficial impact on movement of delta smelt by enhancing access to Middle River, Grant Line Canal, and Old River. Measurable benefits to delta smelt, however, are likely small considering the assumed high probability that larval and juvenile delta smelt spawned in the south Delta would be entrained in diversions (see the following section on Entrainment).

Splittail

The following assessment identifies potential construction-related impacts of implementing Alternative 2A on splittail. The assessment also identifies the impacts on splittail as a result of operating the gates. Adult and juvenile splittail spend most of their lives in the Delta and Suisun Bay. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages.

Impact Fish-21: Construction-Related Loss of Spawning Habitat Area for Splittail. Some splittail spawn within and downstream of the Delta (U.S. Fish and Wildlife Service 1996), where adults deposit eggs on vegetation along the edges of tidal channels. Gate construction and dredging activities in the Delta could affect spawning habitat.

Shallow areas that may provide spawning habitat for splittail could be permanently modified by construction of the gates in the south Delta and subsequent maintenance activities. The area of shallow habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, "Project Description," and Section 5.6, Sediment Transport). The permanent gates constructed under Alternative 2A would have minimal effect on habitat within the construction footprint at the head of Old River, Middle River, and Old River at DMC. Construction of the temporary barriers has previously modified shallow water habitat. These permanent gates would be constructed in the same location as the temporary barriers and would result in little change in habitat quality and quantity relative to existing conditions.

Construction of a new gate on Grant Line Canal and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing shallow habitat. Relative to spawning on inundated floodplain (Sommer et al. 1997), spawning habitat along the south Delta channels is likely of minor importance to maintaining population abundance. Nonnative species currently dominate the fish community in shallow areas of the south Delta (Feyrer 2001), and many of the species prey on splittail eggs, larvae, and juveniles.

Spawning habitat loss associated with gate construction, maintenance activities, and dredging is determined to be less than significant for the same reasons discussed for spawning habitat for delta smelt (Impact Fish-14). In addition, the determination is based on the small area of habitat relative to inundated floodplain and upstream areas. No mitigation is required.

Impact Fish-22: Construction-Related Loss of Rearing Habitat Area for Splittail. Splittail rear in the Delta, and construction of the gates in the south Delta and maintenance activities have the potential to permanently modify shallow vegetated areas that may provide rearing habitat. The area of shallow vegetated habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, "Project Description," and Section 5.6, Sediment Transport).

As discussed under spawning habitat area, the permanent gates constructed under Alternative 2A would have minimal effect on habitat within the construction footprint at the head of Old River, Middle River, and Old River at DMC. Construction of the temporary barriers has previously modified shallow water habitat. These permanent gates would be constructed in the same location as the temporary barriers and would result in little change in habitat quality and quantity relative to existing conditions.

Construction of a new gate on Grant Line Canal and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing shallow habitat. Although the loss of shallow habitat in the Delta has not been explicitly identified as a factor contributing to the decline of splittail (U.S. Fish and Wildlife Service 1996), splittail are known to rear in the south Delta and use shallow vegetated areas (Feyrer 2001; Grimaldo et al. 2000).

Relative to historical extent, existing availability of shallow areas is limited. Therefore, loss of additional shallow area that may represent rearing habitat for splittail could contribute to the historical loss and to an ongoing adverse impact.

The relative importance of specific areas within the Delta and habitat types to growth and survival of splittail is currently unknown. Areas colonized by nonnative aquatic vegetation (e.g., *Egeria densa)* may not provide habitat for splittail (Grimaldo et al. 2000). Nonnative species currently dominate the fish community in shallow vegetated areas of the south Delta (Feyrer 2001) and many of the species prey on larval and juvenile splittail.

Rearing habitat loss associated with gate construction, maintenance activities, and dredging is determined to be less than significant for the same reasons discussed under spawning habitat (Impact Fish-21). No mitigation is required.

Impact Fish-23: Construction-Related Reduction in Food Availability for Splittail. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for adult, larval, and juvenile splittail. Construction of the gates in the south Delta and maintenance activities have the potential to permanently modify shallow vegetated areas and remove bottom substrates that may produce food for splittail. The area of prey habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, "Project Description," and Section 5.6, Sediment Transport).

The construction footprints of the head of Old River, Middle River, and Old River near DMC gates, would have a minimal effect on prey habitat. Construction of the temporary barriers has previously modified shallow water areas and channel bottom substrates. The permanent gates would be constructed in the same location as the temporary barriers and would result in little change in prey habitat quality and quantity relative to existing conditions.

Construction of a new gate on Grant Line Canal and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing shallow vegetated areas and channel bottom substrate. Prey habitat loss associated with gate construction, riprap, maintenance activities, and dredging is determined to be less than significant. The determination is the same as discussed for Chinook salmon (Impact Fish-2). The area affected by gate construction and riprap placement is small relative to availability of similar vegetated areas and bottom substrates in adjacent channel reaches. Also, benthic invertebrates are expected, based on changes in benthic invertebrate abundance observed in response to changes in salinity (Markham 1986; Vayssieres and Peterson 2003), to recolonize bottom substrates disturbed by dredging relatively quickly. Construction would have a minimal effect on prey availability, especially over the long term. This impact is less than significant. No mitigation is required.

Impact Fish-24: Construction-Related Loss of Splittail to Accidental Spill of Contaminants. Potential contaminant impacts on splittail attributable to construction activities in the south Delta, including gate construction, placement of riprap, dredging, and maintenance dredging, are the same as described previously for Chinook salmon (Impact Fish-3). The impact on splttial is considered less than significant because environmental commitments would substantially reduce the likelihood of any considerable contaminant input. No mitigation is required.

Impact Fish-25: Construction-Related Loss of Splittail to Direct Injury. The potential for direct injury impacts attributable to construction activities in the south Delta is less than significant, the same as described previously for Chinook salmon (Impact Fish-4). The number of fish injured during construction is likely small given that:

- in-water construction, including the construction of a cofferdam, would occur between August and November;
- the area of construction activity is small relative to the channel area providing similar habitat quality in the south Delta;
- in-water construction and dredging would occur over a relatively short period (i.e., about 3 years); and
- most juvenile and adult splittail would move away from construction activities and into adjacent habitat of similar quality.

No mitigation is required.

Impact Fish-26: Construction-Related Loss of Splittail to Predation. Predation impacts attributable to construction activities in the south Delta are less than significant, the same as described previously for Chinook salmon (Impact "Fish-5"). Increased predation could be associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels. Design elements, however, will minimize turbulence that could disorient fish and increase vulnerability to predation. The structures would not create conditions that could concentrate splittail. The increase in potential predator habitat is small relative to habitat in adjacent areas, including the habitat currently created by the temporary barriers and habitat at the existing agricultural diversion intakes. Disorientation and concentration of juvenile fish would be minimal given the size and design of the gates. This impact is less than significant. No mitigation is required.

Impact Fish-27: Effects of Gate Operation on Splittail Migration. Under the No Action Alternative, the head of Old River temporary barrier is in place from April 14 through June 1. Under Alternative 2A, the head of Old River fish control gate could be closed from April 1 to May 31. During high flow years when splittail spawn in the San Joaquin River, gate closure would minimize the movement of juvenile splittail into Old River. Although the effects of gate closure on splittail are unknown, the operable gates constructed under Alternative 2A would provide increased opportunities for fish protection in response to new information on splittail survival for variable flows and migration pathways. The increased flexibility in operation provided by the gates is a beneficial impact.

Gates in Middle River, Grant Line Canal, and Old River near Byron could affect access to rearing habitat in the south Delta channels and passage through the channels by juvenile splittail during operation from April through September. Operable gates could have a beneficial impact on movement of adult and juvenile splittail because of increased circulation and the potential management flexibility to provide access to Middle River, Grant Line Canal, and Old River.

Striped Bass

The following assessment identifies potential construction-related impacts of implementing Alternative 2A on striped bass. The assessment also identifies the impacts on striped bass as a result of operating the gates. Striped bass occur within the Delta, Suisun Bay, San Francisco Bay, and in the coastal waters near San Francisco Bay. Adult striped bass migrate upstream in the Sacramento River to spawn. Some juvenile and adult striped bass occur in rivers upstream of the Delta throughout the year. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages.

Impact Fish-28: Construction-Related Loss of Spawning Habitat Area for Striped Bass. Striped bass spawning in the Delta usually occurs within the San Joaquin River channel between Antioch and upstream to Venice Island (California Department of Fish and Game 1987). This spawning habitat area would not be affected by construction activities in the south Delta. This impact is less than significant. No mitigation is required.

Impact Fish-29: Construction-Related Loss of Rearing Habitat Area for Striped Bass. Striped bass larvae, juveniles, and adults rear in the Delta and Suisun Bay. Construction of the gates in the south Delta and maintenance activities have the potential to permanently modify channel areas that may provide rearing habitat for striped bass. The area of habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, “Project Description,” and Section 5.6, Sediment Transport).

The construction footprint of the head of Old River, Middle River, and Old River near DMC gates would have a mimimal effect on striped bass rearing habitat. Construction of the temporary barriers has previously modified channel habitat. The permanent gates would be constructed in the same location as the temporary barriers and would result in little change in habitat quality and quantity relative to existing conditions.

Construction of a new gate on Grant Line Canal and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing channel habitat. Rearing habitat loss associated with gate construction, maintenance activities, and dredging is determined to be less than significant.

The determination is the same as discussed for delta smelt rearing habitat (Impact Fish-15). No mitigation is required.

Impact Fish-30: Construction-Related Reduction in Food Availability for Striped Bass. The construction-related effects on the availability of food for striped bass would be the same as described for delta smelt (Impact Fish-16). This impact is considered less than significant and no mitigation is required.

Impact Fish-31: Construction-Related Loss of Striped Bass to Accidental Spill of Contaminants. The construction-related effects on striped bass as a result of accidental spill of contaminants would be the same a described for delta smelt (Impact Fish-17). The impact on striped bass is considered less than significant and no mitigation is required.

Impact Fish-32: Construction-Related Loss of Striped Bass to Direct Injury. Construction of the gates would include placement of sheetpiles and riprap and could directly injure fish present during the time of construction. Dredging could entrain and injure striped bass. Cofferdams, if used, would be installed to isolate gate construction areas from the channel. Placement of cofferdams in the channels could trap larval, juvenile, and adult striped bass. Fish that become trapped inside the cofferdams could be killed during desiccation of the construction area and construction activities. Direct injury associated with construction and maintenance activities, including dredging, would have a less-than-significant impact on striped bass because the number of fish injured is likely small given that:

- in-water construction, including the construction of a cofferdam, would occur between August and November;
- the area of construction activity is small relative to the channel area providing similar habitat quality throughout the Delta; and
- most juvenile and adult striped bass would move away from construction activities and into adjacent habitat of similar quality.

No mitigation is required.

Impact Fish-33: Construction-Related Loss of Striped Bass to Predation. Construction of gates and extension of agricultural intakes would add permanent structure and cover to the south Delta channels. As indicated for Chinook salmon (Impact Fish-5), the addition of structure has the potential to increase the density of predator species and predation on fish moving around and past the structure. Concentrations of disoriented fish increase prey availability and create predator habitat.

Predation associated with the addition of the gates and the agricultural intake extensions to the south Delta channels could cause a small and likely negligible (i.e., less-than-significant impact) increase in mortality of the larval and juvenile striped bass moving past the structures. The determination is based on several factors. Design elements will minimize turbulence that could disorient fish and increase vulnerability to predation. The structures would not create conditions that could concentrate striped bass. Flow velocity would be similar to velocities within the channel upstream and downstream of the gates and agricultural intake extensions.

The transition zones between various elements of the gates (e.g., sheetpiles and riprap) could provide low-velocity holding areas for predatory fish, including juvenile and adult striped bass. Predatory fish holding near the gates and agricultural intakes could prey on larvae and smaller juvenile striped bass. The additional predator habitat created by the gates and intake extensions would have a less-than-significant impact on striped bass because the increase in potential predator habitat is small relative to habitat in adjacent areas, including the habitat currently provided by the temporary barriers and habitat at the existing agricultural intakes. Disorientation and concentration of juvenile and adult fish would be minimal given the size and design of the gates. This impact is less than significant. No mitigation is required.

Impact Fish-34: Effects of Gate Operation on Striped Bass Migration. As discussed for delta smelt, the effects of gate closure are similar for Alternatives 1 and 2A. The operable gate constructed under Alternative 2A, however, would provide increased opportunities for fish protection in response to new information on fish survival for variable flows and migration pathways. The increased flexibility is a beneficial impact. Gates in Middle River, Grant Line Canal, and Old River would have the same effect on striped bass as described for delta smelt. Operation of the permanent flow control gates on Middle River, Grant Line Canal, and Old River under Alternative 2A could have a beneficial effect relative to the existing temporary barriers (i.e., Alternative 1).

Green Sturgeon

The following assessment identifies potential construction-related impacts of implementing Alternative 2A on green sturgeon. Green sturgeon occur within the Delta, Suisun Bay, San Francisco Bay, and in the coastal waters near San Francisco Bay. Adult green sturgeon migrate upstream in the Sacramento River to spawn. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages.

Impact Fish-35: Construction-Related Loss of Spawning Habitat Area for Green Sturgeon. Green sturgeon spawning usually occurs in the upper reach of the Sacramento River (Moyle 2002). Spawning habitat area would not be affected by construction activities in the south Delta. This impact is less than significant. No mitigation is required.

Impact Fish-36: Construction-Related Loss of Rearing Habitat Area for Green Sturgeon. Green sturgeon juveniles may rear in the Delta and Suisun Bay, but there is no data indicating which areas are used by juvenile green sturgeon. The area of habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, “Project Description,” and Section 5.6, Sediment Transport).

The permanent gates constructed under Alternative 2A would have minimal effect on habitat within the construction footprint at the head of Old River, Middle River, and Old River near Byron. Construction of the temporary barriers has previously modified channel habitat. The permanent gates would be constructed in the same location as the temporary barriers and would result in little change in habitat quality and quantity relative to existing conditions.

Construction of a new gate on Grant Line Canal and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing channel habitat. Rearing habitat loss associated with gate construction, maintenance activities, and dredging is determined to be less than significant. The determination is based on:

- the area disturbed by construction of gates on Middle River, Old River at DMC, and the head of Old River would be similar to the existing footprint of the temporary barriers;
- the footprint of the gate on Grant Line Canal would be in a new location, but the absence of the temporary barrier footprint would reestablish a similar area of rearing habitat;
- dredging would increase channel depth, but habitat area would remain unchanged and habitat quality would be similar (i.e., shallow water; [the resulting bottom elevation is less than 3 m below MLLW]) following the temporary disturbance of substrate; and
- implementation of a dredge monitoring program to confirm minimal effects of dredging on rearing habitat (see Chapter 2, “Project Description”).

No mitigation is required.

Impact Fish-37: Construction-Related Reduction in Food Availability for Green Sturgeon. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for adult and juvenile green sturgeon. Construction of the gates in the south Delta and maintenance activities have the potential to permanently modify shallow vegetated areas and remove bottom substrates that may produce food for green sturgeon. The area of prey habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, “Project Description,” and Section 5.6, Sediment Transport).

The permanent gates constructed under Alternative 2A would have minimal effect on prey habitat within the construction footprint at the head of Old River, Middle River, and Old River near Byron. Construction of the temporary barriers has previously modified shallow water areas and channel bottom substrates. The permanent gates would be constructed in the same location as the temporary barriers and would result in little change in prey habitat quality and quantity relative to existing conditions.

Construction of a new gate on Grant Line Canal and the proposed dredging in West Canal, Middle River, and Old River potentially would remove and modify existing shallow vegetated areas and channel bottom substrate.

The area affected by gate construction and riprap placement is small relative to availability of similar vegetated areas and bottom substrates in adjacent channel reaches. Also, benthic invertebrates are expected, based on changes in benthic invertebrate abundance observed in response to changes in salinity (Markham 1986; Vayssieres and Peterson 2003) and dredging (Wilson 1998), to recolonize bottom substrates disturbed by dredging relatively quickly. Construction would have a minimal effect on prey availability, especially over the long term. Prey habitat loss associated with gate construction, riprap, maintenance activities, and dredging is determined to be less than significant. No mitigation is required.

Impact Fish-38: Construction-Related Loss of Green Sturgeon to Accidental Spill of Contaminants. Contaminants associated with construction activities, including gate construction, placement of riprap, dredging, and maintenance dredging, could be introduced into the south Delta channels and could adversely affect adult green sturgeon during migration and juveniles rearing in the Delta. 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, "Project Description"). The environmental commitments would substantially reduce the likelihood of any considerable contaminant input. Contaminants would have a less-than-significant impact on green sturgeon moving through, and rearing in, the south Delta because the potential for increased contaminant input following implementation of environmental commitments is small. No mitigation is required.

Impact Fish-39: Construction-Related Loss of Green Sturgeon to Direct Injury. Construction of the gates would include placement of sheetpiles and riprap and could directly injure fish present during the time of construction. Dredging could entrain and injure green sturgeon. Cofferdams, if used, would be installed to isolate gate construction areas from the channel. Placement of cofferdams in the channels could trapjuvenile and adult green sturgeon. Fish that become trapped inside the cofferdams could be killed during desiccation of the construction area and construction activities. Direct injury associated with construction and maintenance activities, including dredging, would have a less-than-significant impact on green sturgeon. This determination is based on the fact that:

- the area of construction activity is small relative to the channel area providing similar habitat quality in the south Delta;
- in-water construction and dredging would occur over a relatively short period (i.e., about 3 years) and be limited to the August to November timeframe; and
- most juvenile and adult green sturgeon would move away from construction activities and into adjacent habitat of similar quality.

No mitigation is required.

Impact Fish-40: Construction-Related Loss of Green Sturgeon to Predation. Increased predation could be associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels. Design elements, however, will minimize turbulence that could disorient fish and increase vulnerability to predation. The structures would not create conditions that could concentrate green sturgeon. The increase in potential predator habitat is small relative to habitat in adjacent areas, including the habitat currently created by the temporary barriers and habitat at the existing agricultural diversion intakes. Disorientation and concentration of juvenile fish would be minimal given the size and design of the gates. This impact is less than significant. No mitigation is required.

Impact Fish-41: Effects of Gate Operation on Green Sturgeon Migration. The head of Old River fish control gate could be closed from April 14 to June 1 under both Alternatives 1 and 2A. Under Alternative 1, a temporary fixed barrier is constructed each year. Under Alternative 2A, an operable gate would be constructed with bottom-hinged gates that would allow a range of operations. Currently, there is no available data about the migratory paths of adult or juvenile green sturgeon. If green sturgeon migrate through the South Delta, the gate closure could minimize the movement of green sturgeon into the Sacramento River and out to the Pacific ocean. The effects of gate closure on sturgeon that may use the South Delta as a migratory path are unknown. However, closure of the Old River fish control gate would not preclude juvenile and adult sturgeon movement between the San Joaquin River upstream of Old River and the Sacramento River or Pacific Ocean. Closure of the head of Old River fish control gate increases the San Joaquin River flow past Stockton and green sturgeon that may migrate through the South Delta would presumably use the route past Stockton to migrate into the Saramento River and out to the Pacific Ocean. This impact is less than significant. No mitigation is required. Other gate operations would have the same effect on sturgeon.

2020 Conditions

The impacts associated with Stage 1 of Alternative 2A under 2020 conditions would be the same as those described above under 2001 conditions (see Alternative 2A under 2001 conditions above). Permanent gates constructed and operated at the head of Old River and in Middle River, Grant Line Canal, and Old River would potentially affect environmental conditions in the south Delta and are expected to be the same as those described for 2001. Fish, surface water, hydrology, and water quality impacts associated with construction under 2020 conditions would be the same as described above for Alternative 2A under 2001 conditions. Impacts from construction of the physical/structural component of Alternative 2A under 2020 conditions would be the same as those under 2001 conditions. Therefore, construction-related impacts on Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon are identical to the physical/structural impacts described for Alternative 2A under 2001 conditions (Impact Fish-1 through Impact Fish-41).

Stage 2 (Operational Component)

Relative to existing conditions, water supply operations with implementation of SDIP Alternative 2A would increase Delta pumping, changing CVP and SWP diversions and operation of CVP and SWP reservoirs (Section 5.1, Water Supply). Maximum CCF and SWP Banks diversion and pumping in any month would not exceed 8,500 cfs on an average monthly basis (Chapter 2, "Project Description"). Changes in flow and diversions may affect fish and fish habitat in reaches of the Trinity, Sacramento, Feather, American, and San Joaquin Rivers and in the Delta and Suisun Bay. Simulated flow, SWP and CVP pumping, and water temperature conditions are evaluated. Environmental conditions potentially affected with implementation of the SDIP under Alternative 2A are summarized in Table 6.1-12.

Water temperature conditions in the south Delta appear to be unaffected by changes in SWP and CVP pumping and gate operation. For all months of the year, measured water temperature at Mossdale during 2000 and 2001 is similar to the measured water temperature in Old River, Middle River, and the San Joaquin River near Stockton (Section 5.3, Water Quality; Figure 5.3-1). Water temperature conditions are determined by weather conditions; therefore, temperature effects on fish species in the Delta are not discussed further.

Alternative 2A would result in little to no change in reservoir storage patterns (see Section 5.1, Water Supply). Effects of reservoir storage on fish habitat (i.e., shallow water area) in Trinity, Shasta, Oroville, San Luis, and Folsom Reservoirs would be similar to existing water supply operations criteria.

The simulated flow volume for 1922–1994 for the San Joaquin River and its tributaries under Alternative 2A is similar to the simulated flow under Alternative 1 (Figure 6.1-4). Therefore, effects of flow and water temperature conditions on fish and fish habitat in the San Joaquin River are not considered further. Similarly, flow in the Trinity River under Alternative 2A is nearly the same as flow under Alternative 1, with increased flow in a few months (Figure 6.1-4). Although changes in flow conditions on fish habitat are not considered further, changes in water temperature could occur and are assessed in detail (see discussion of water temperature that follows).

Flows under Alternative 2A for the Sacramento, Feather, and American Rivers frequently vary from monthly flows under Alternative 1 (Figure 6.1-5). A consistent pattern of higher or lower flows, however, is not apparent. Specific effects on spawning and rearing habitat for Chinook salmon, steelhead, and splittail are discussed in following sections.

Changes in Delta inflow from the Sacramento River reflect the cumulative effects of flow changes upstream on the Sacramento, Feather, and American Rivers (Figure 6.1-6). Changes in Sacramento River inflow potentially affect the proportion of flow drawn into the DCC and Georgiana Slough, although the effects appear to be relatively small (Figure 6.1-7). Changes in Delta outflow are similarly small relative to the outflow volume under Alternative 1, although slightly lower outflow results in some months (Figure 6.1-6).

Delta outflow affects the downstream extent of fresh water and the estuarine salinity distribution. The parameter X2 (the distance in kilometers of the 2-ppt isohaline from the Golden Gate Bridge) is an indicator of potential effects of Delta outflow changes on salinity distribution in Suisun Bay and the western Delta. Comparison of X2 for Alternative 1 and Alternative 2A indicates that for most months salinity distribution is similar (Figure 6.1-8). However, an upstream shift is relatively frequent during September, October, and November.

Monthly SWP and CVP pumping for Alternative 2A varies from pumping that was simulated for Alternative 1 (Figure 6.1-9). On average, CVP pumping is similar for Alternatives 1 and 2A, but SWP pumping, averaged over the 73-year simulation, increases for every month. Although changes in exports are generally small, SWP pumping increases by at least 10% of the baseline pumping in every month during at least 10% of the simulated years (1922–1994).

Chinook Salmon

The following assessment identifies potential operations-related impacts of implementing Alternative 2A on winter-, spring-, and fall-/late fall–run Chinook salmon in Central Valley rivers and the Delta. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages for each run. Environmental correlates addressed for Chinook salmon include spawning habitat quantity, rearing habitat quantity, migration habitat condition, water temperature, food, and entrainment in diversions.

Impact Fish-42: Operations-Related Loss of Spawning Habitat Area for Chinook Salmon. Fall-/late fall–run Chinook salmon spawn in the cool reaches of the Sacramento, Feather, and American Rivers downstream of Shasta, Oroville, and Folsom Reservoirs. Changes in water supply operations potentially affect spawning habitat area for Chinook salmon in the Sacramento, Feather, and American Rivers. The spawning and egg incubation period for fall-/late fall–run Chinook salmon extends from October through May in the Sacramento River and October through February in the Feather and American Rivers. Winter-run Chinook salmon spawn in the Sacramento River, generally above RBDD, and spring-run Chinook salmon spawn in the cool reaches of the Sacramento and Feather Rivers. The spawning and egg incubation period for winter-run Chinook salmon extends from April through September. The spawning and egg incubation period for spring-run Chinook salmon extends from August through December.

Flows simulated for Alternative 1 provide near the maximum spawning habitat area during the months of spawning for winter-, spring-, fall-, and late fall–run Chinook salmon in the Sacramento River (Table 6.1-8). Change in Sacramento River flow attributable to water supply operations under Alternative 2A would not affect spawning habitat area for any run (Table 6.1-13). Similarly, change in

Feather River flow attributable to water supply operations under Alternative 2A would not affect spawning habitat area for spring- and fall-run Chinook salmon. In the American River, spawning habitat area for fall-run Chinook salmon is not affected during most months (Table 6.1-13), and varies between less and more abundant in a few months. The reduction in area is generally less than 10% and does not affect spawning for all months in any year. Given the few spawning months affected and the relatively small change in spawning habitat area, the effect on adult spawning success and survival of fall-run Chinook salmon eggs and larvae through incubation in the American River would be less than significant. No mitigation is required.

Impact Fish-43: Operations-Related Loss of Rearing Habitat Area for Chinook Salmon. Changes in water supply operations potentially affect rearing habitat area for Chinook salmon in the Sacramento, Feather, and American Rivers. Fall-run Chinook salmon rear in the Sacramento, Feather, and American Rivers from January through May. Winter-run Chinook salmon rear in the Sacramento River upstream and downstream of RBDD, and spring-run Chinook salmon rear in the cool reaches of the Sacramento and Feather Rivers. The rearing period for winter-run Chinook salmon can extend from July through April. The rearing period for spring-run Chinook salmon extends through all months of the year, although most rearing occurs from November through May. Some late fall–run Chinook salmon rear in the Sacramento River from March through November, with most rearing from April through November.

The flow simulated for 1922–1994 in the Sacramento, Feather, and American Rivers for Alternative 2A varies relative to flow under Alternative 1 (Figure 6.1-5). The reduction in flow in some months and increases for other months and years have minimal effect on the range of flows that could affect rearing habitat area (Table 6.1-14). The impact on Chinook salmon of any run would be less than significant.

Inundated floodplain in the Yolo and Sutter Bypasses provides important rearing habitat for juvenile Chinook salmon (Sommer and Harrell et al. 2001). Changes in water supply operations affect reservoir storage and may affect the frequency of floodplain inundation. Inundation of the Yolo Bypass has occurred in approximately 60% of the historical water years (Sommer and Harrell et al. 2001), and inundation of the Sutter Bypass occurs in at least 80%. Monthly average flows provide an indicator of inundation, although weekly and shorter storm events that inundate floodplain are not captured by the monthly average. The frequency of floodplain inundation in the Yolo and Sutter Bypasses was estimated under Alternative 1 for the 1922–1994 water years (Figure 6.1-10). Most flooding occurs from December though April, coinciding with downstream movement and rearing by juvenile Chinook salmon in all runs (Table 6.1-2). Changes in water supply operations under Alternative 2A could reduce flooding in November of one year for the Sutter Bypass and in December of two years for the Yolo Bypass. The reduced bypass flooding in November and December would have a less-than-significant impact on the expected growth and survival of juvenile Chinook salmon for any run. No mitigation is required. The determination is based on several factors. Few months are affected, with

Table 6.1-13. Frequency of Change (Relative to Alternative 1) in Monthly Spawning Habitat Availability for Steelhead and Chinook Salmon in the Feather, Sacramento, and American Rivers for Alternative 2A, 1922–1994 Simulation (2001 Operations)

	Sacramento River					Feather River			American River	
Change in Percentage Area	Fall-Run Chinook Salmon	Late Fall–Run Chinook Salmon	Winter-Run Chinook Salmon	Spring-Run Chinook Salmon	Steelhead	Fall-Run Chinook Salmon	Spring-Run Chinook Salmon	Steelhead	Fall-Run Chinook Salmon	Steelhead
<+100%	0	0	0	0	0	0	0	0	0	0
<+90%	0	0	0	0	0	0	0	0	0	0
<+80%	0	0	0	0	0	0	0	0	0	0
<+70%	0	0	0	0	0	0	0	0	0	0
<+60%	0	0	0	0	0	0	0	0	0	0
<+50%	0	0	0	0	0	0	0	0	0	0
<+40%	0	0	0	0	0	0	0	0	2	1
<+30%	0	0	0	0	0	0	0	0	2	0
<+20%	0	0	0	0	0	0	0	0	4	3
<+10%	0	0	0	0	0	0	0	0	6	5
0%	219	219	292	219	365	219	219	365	183	342
>-10%	0	0	0	0	0	0	0	0	17	10
>-20%	0	0	0	0	0	0	0	0	1	3
>-30%	0	0	0	0	0	0	0	0	1	1
>-40%	0	0	0	0	0	0	0	0	3	0
>-50%	0	0	0	0	0	0	0	0	0	0
>-60%	0	0	0	0	0	0	0	0	0	0
>-70%	0	0	0	0	0	0	0	0	0	0
>-80%	0	0	0	0	0	0	0	0	0	0
>-90%	0	0	0	0	0	0	0	0	0	0
>=-100%	0	0	0	0	0	0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-14. Frequency of Occurrence of the Percentage Change in Monthly Flow from Alternative 1 that Could Affect Rearing Habitat Area for Steelhead and Chinook Salmon in the Sacramento, Feather, and American Rivers for Alternative 2A, 1922–1994 Simulation

	Sacramento River					Feather River			American River	
Percentage Change in Flow	Fall-Run Chinook Salmon	Late Fall–Run Chinook Salmon	Winter-Run Chinook Salmon	Spring-Run Chinook Salmon	Steelhead	Fall-Run Chinook Salmon	Spring-Run Chinook Salmon	Steelhead	Fall-Run Chinook Salmon	Steelhead
<+100%	0	0	0	0	0	0	0	0	0	2
<+90%	0	0	0	0	0	0	0	1	0	0
<+80%	0	0	0	0	0	0	1	3	0	0
<+70%	0	0	0	0	0	0	0	0	1	3
<+60%	0	0	0	0	0	0	0	2	0	1
<+50%	1	1	2	1	2	0	0	2	0	2
<+40%	0	1	1	1	1	1	1	4	3	5
<+30%	2	0	3	3	3	0	0	2	2	4
<+20%	3	3	6	5	6	1	2	2	2	11
<+10%	0	0	0	0	0	0	0	0	0	0
0%	429	572	702	486	848	430	499	830	417	802
>-10%	0	0	0	0	0	0	0	0	0	0
>-20%	2	2	8	7	8	0	2	7	7	22
>-30%	0	5	6	6	6	3	3	5	1	8
>-40%	1	0	2	2	2	0	0	1	1	6
>-50%	0	0	0	0	0	0	0	1	1	1
>-60%	0	0	0	0	0	2	2	4	1	3
>-70%	0	0	0	0	0	0	0	0	0	4
>-80%	0	0	0	0	0	0	0	0	0	0
>-90%	0	0	0	0	0	0	0	1	0	0
>=-100%	0	0	0	0	0	0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

inundation predicted in 143 months for the Sutter Bypass and 100 months for the Yolo Bypass (1922–1994 simulation). The affected months are early in the period of downstream migration of juvenile Chinook salmon. In addition, the probability of flooding in months subsequent to the 3 affected months, and the subsequent availability of floodplain rearing habitat, is higher for January, February, and March. Therefore, access to floodplain habitat may be delayed but habitat would likely be available in a subsequent month.

Impact Fish-44: Operations-Related Decline in Migration Habitat Conditions for Chinook Salmon. The Sacramento, Feather, and American Rivers provide a migration pathway between freshwater and estuarine habitats for Chinook salmon. Flows that occur in Central Valley rivers support migration of adult and juvenile Chinook salmon and steelhead. Relative to Alternative 1, the change in flows under Alternative 2A would not be expected to affect migration of adult and juvenile Chinook salmon in Central Valley rivers (Figures 6.1-4 and 6.1-5). Flows under Alternative 2A are within the range of flows that are simulated under Alternative 1.

In the Delta, juvenile Chinook salmon survival is lower for fish migrating through the central Delta than for fish continuing down the Sacramento River channel (Brandes and McLain 2001; Newman and Rice 1997). Juvenile spring-, winter-, and late fall–run Chinook salmon begin entering the Delta from upstream habitat in the Sacramento River and its tributaries during late October and November. Downstream movement and migration continue through April or May, joined by fall-run juveniles from February through June. Few juvenile Chinook salmon move through the Delta from July through September.

Juvenile Chinook salmon are assumed to move along Delta channel pathways in proportion to flow; therefore, an increase in the proportion of flow diverted off the Sacramento River through the DCC and Georgiana Slough would be expected to increase mortality of migrating juvenile Chinook salmon. The proportion of Sacramento River flow diverted into the DCC and Georgiana Slough under Alternative 2A is generally the same as the proportion diverted under Alternative 1 (Figure 6.1-7), especially during the primary period of juvenile Chinook salmon migration from November through May (Table 6.1-2). For the primary migration period, the change in flow is usually less than 1% (Figure 6.1-7). The frequency of change in the proportion of flow diverted under Alternative 2A is higher from June through October, but most of the time the change is small (less than 2%) relative to the proportion under Alternative 1. Operations under Alternative 2A would have a less-than-significant impact on survival of juvenile Chinook salmon migrating from the Sacramento River because the proportion of flow diverted off the Sacramento River at the DCC and Georgiana Slough is similar to the proportion of flow diverted under Alternative 1.

For the San Joaquin River, the flow split at the head of Old River determines the pathway of juvenile fall-run Chinook salmon through the south Delta. Available data indicate that survival of fish continuing down the San Joaquin River past Stockton is higher than survival of fish that move into Old River (San Joaquin

River Group Authority 2003; Brandes and McLain 2001). The relationships, however, have not proved to be statistically different over multiple years and variable hydrologic conditions. Flow in the San Joaquin River is the same under Alternatives 1 and 2A (Figure 6.1-4) and would not affect the proportion of flow drawn into Old River.

SWP and CVP pumping, also a factor in the proportion of flow diverted off the San Joaquin River at the head of Old River, would increase under Alternative 2A Figure 6.1-9 shows the monthly range of combined CVP and SWP pumping for the 2001 baseline (Alternative 1) and operations scenario A (Alternative 2A), as well as the average monthly change in combined pumping. The range of pumping simulated by the CALSIM model is shown as the minimum, maximum, and 10^{th} percentile values from the 73-year simulation of 1922–1994. The average pumping is also shown for each month.

An increase in CVP and SWP pumping of approximately 2,000 cfs could increase the proportion of flow drawn into Old River by about 10% (Section 5.2, Delta Tidal Hydraulics). During the primary period of juvenile fall-run movement in April and May, the maximum monthly increase in simulated export was less than 500 cfs and would result in less than 2.5% change in the proportion of San Joaquin River flow drawn into Old River. Flow and pumping changes under Alternative 2A would have minimal effect on movement and survival of juvenile Chinook salmon.

Impact Fish-45: Operations-Related Reduction in Survival of Chinook Salmon in Response to Changes in Water Temperature. Change in reservoir storage and river flow potentially affects water temperature in the Sacramento, Feather, and American Rivers. Water temperature in river reaches immediately downstream of the primary reservoirs, including Shasta, Oroville, and Folsom, are the most sensitive to effects of operations. These reaches support Chinook salmon life stages that can be adversely affected by temperature conditions in Central Valley rivers.

Water temperatures in the Sacramento, Feather, and American Rivers are similar under Alternative 1 and Alternative 2A (Figures 6.1-11 and 6.1-12). The change in monthly water temperatures attributable to Alternative 2A is almost always less than 1°F (0.56°C), although larger changes occur in some simulated months. The magnitude and frequency of changes are too small and too infrequent to attribute to any specific SDIP action. The potential effect of water temperature on steelhead and Chinook salmon life stages warrants further consideration of the range of water temperatures affecting survival. Survival indices were assigned to the water temperatures for each month of occurrence of each life stage for Chinook salmon (winter-, spring-, and fall-/late fall–run) in the Sacramento, Feather, and American Rivers.

For all life stages of all runs in the Sacramento River near Keswick, the water temperature survival indices are near optimal in most months under Alternative 1 (Table 6.1-15). The indices are similarly high at Bend Bridge and RBDD (Tables 6.1-16 and 6.1-17), although less than optimal indices are more frequent

Table 6.1-15. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Sacramento River at Keswick for Alternative 1, 1922–1993 Simulation (2001 Operations)

	Fall-Run Chinook Salmon				Fall-/Late Fall–Run Chinook Salmon				Winter-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Base Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
1.0	410	410	432	216	554	554	864	648	576	411	720	504	491	322	864	576	485	498	864	432
0.9	9	9	0	0	9	9	0	0	0	1	0	0	2	8	0	0	8	5	0	0
0.8	2	3	0	0	2	3	0	0	0	3	0	0	0	5	0	0	3	0	0	0
0.7	3	0	0	0	3	0	0	0	0	1	0	0	3	0	0	0	2	1	0	0
0.6	5	1	0	0	5	1	0	0	0	3	0	0	5	3	0	0	5	0	0	0
0.5	3	1	0	0	3	1	0	0	0	0	0	0	3	1	0	0	1	0	0	0
0.4	0	2	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0
0.3	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
0.0	0	4	0	0	0	4	0	0	0	13	0	0	0	17	0	0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-16. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Sacramento River at Bend Bridge for Alternative 1, 1922–1993 Simulation (2001 Operations)

	Fall-Run Chinook Salmon				Fall-/Late Fall–Run Chinook Salmon				Winter-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Base Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
1.0	401	409	432	216	545	535	859	648	576	304	715	504	482	277	859	576	480	380	858	432
0.9	15	10	0	0	15	26	5	0	0	86	5	0	7	42	5	0	11	93	6	0
0.8	3	1	0	0	3	1	0	0	0	14	0	0	2	9	0	0	5	18	0	0
0.7	2	3	0	0	2	5	0	0	0	6	0	0	2	5	0	0	1	8	0	0
0.6	5	0	0	0	5	0	0	0	0	0	0	0	5	0	0	0	4	2	0	0
0.5	0	2	0	0	0	2	0	0	0	0	0	0	0	2	0	0	1	0	0	0
0.4	3	1	0	0	3	1	0	0	0	1	0	0	3	1	0	0	2	1	0	0
0.3	2	1	0	0	2	1	0	0	0	0	0	0	2	1	0	0	0	1	0	0
0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0.1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0.0	0	5	0	0	0	5	0	0	0	21	0	0	0	23	0	0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-17. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Sacramento River at Red Bluff for Alternative 1, 1922–1993 Simulation (2001 Operations)

	Fall-Run Chinook Salmon				Fall-/Late Fall–Run Chinook Salmon				Winter-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Base Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
1.0	397	406	432	216	541	497	858	648	573	153	714	504	475	225	858	576	473	331	858	432
0.9	14	13	0	0	14	59	5	0	3	169	5	0	9	66	5	0	16	70	6	0
0.8	7	1	0	0	7	6	1	0	0	49	1	0	6	20	1	0	6	40	0	0
0.7	2	1	0	0	2	1	0	0	0	20	0	0	2	12	0	0	2	33	0	0
0.6	4	2	0	0	4	2	0	0	0	12	0	0	4	8	0	0	3	8	0	0
0.5	2	2	0	0	2	4	0	0	0	4	0	0	2	3	0	0	2	9	0	0
0.4	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0
0.3	2	2	0	0	2	2	0	0	0	3	0	0	2	3	0	0	2	4	0	0
0.2	2	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0.0	1	5	0	0	1	5	0	0	0	22	0	0	1	23	0	0	0	4	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-18. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Sacramento River at Keswick for Alternative 2A, 1922–1993 Simulation (2001 Operations)

	Fall-Run Chinook Salmon				Fall-/Late Fall–Run Chinook Salmon				Winter-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Change in the Index	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration
<+0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.1	5	6	0	0	5	6	0	0	0	3	0	0	4	7	0	0	6	3	0	0
0.0	418	409	432	216	562	553	862	648	576	417	718	504	497	328	862	576	482	500	863	432
>-0.1	9	15	0	0	9	15	2	0	0	10	2	0	3	21	2	0	16	1	1	0
>-0.2	0	1	0	0	0	1	0	0	0	2	0	0	0	3	0	0	0	0	0	0
>-0.30	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
>-0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-19. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Sacramento River at Bend Bridge for Alternative 2A, 1922–1993 Simulation (2001 Operations)

	Fall-Run Chinook Salmon				Fall-/Late Fall–Run Chinook Salmon				Winter-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Change in the Index	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning /Incubation	Juvenile Rearing	Smolt Migration
<+0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.1	10	6	0	0	10	8	1	0	1	40	1	0	9	27	1	0	1	8	1	0
0.0	402	415	432	216	546	555	861	648	572	369	717	504	485	307	861	576	487	487	860	432
>-0.1	19	10	0	0	19	12	2	0	3	22	2	0	9	24	2	0	16	9	3	0
>-0.2	1	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0
>-0.30	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
>-0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-20. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Sacramento River at Red Bluff for Alternative 2A, 1922–1993 Simulation (2001 Operations)

	Fall-Run Chinook Salmon				Fall-/Late Fall–Run Chinook Salmon				Winter-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Change in the Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
<+0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<+0.2	0	0	0	0	0	0	0	0	0	5	0	0	0	3	0	0	0	3	0	0
<+0.1	8	6	0	0	8	7	1	0	2	72	1	0	7	35	1	0	1	12	1	0
0.0	405	413	432	216	549	549	859	647	571	311	715	503	487	280	859	575	492	473	859	432
>-0.1	18	12	0	0	18	19	4	1	3	41	4	1	9	38	4	1	11	15	4	0
>-0.2	1	0	0	0	1	0	0	0	0	2	0	0	1	2	0	0	0	1	0	0
>-0.30	0	1	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	0	0	0
>-0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

for spawning and incubation at RBDD, especially for spring- and winter-run Chinook salmon. The occurrence of lower indices reflects warming of water temperatures downstream from Keswick Dam and Bend Bridge.

The few months of change in survival indices at Keswick Dam under Alternative 2A illustrate the similarity to indices under Alternative 1 (Table 6.1-18). Water temperature conditions supporting spawning and incubation for fall-/late fall–run Chinook salmon and spring-run Chinook salmon decline during a few months. The infrequent change in the indices would have a less-than-significant impact on survival, especially given that water temperature conditions are near optimal most of the time.

At Bend Bridge and RBDD, change in the survival indices under Alternative 2A is more frequent than occurred at Keswick, especially for winter- and spring-run spawning and incubation (Tables 6.1-19 and 6.1-20). Water temperature conditions supporting spawning and incubation of winter-run Chinook salmon improve in some months. Survival indices for spring-run spawning and incubation do not show a clear pattern of increase or decrease.

Other than the benefit to spawning and incubation for winter-run Chinook salmon at Bend Bridge and RBDD, water temperature survival indices for all runs and life stages of Chinook salmon in the Sacramento River are nearly the same for Alternative 1 and Alternative 2A. The impact on Chinook survival is considered less than significant.

In the Feather River, suboptimal conditions occur during many months for most life stages of spring- and fall-run Chinook salmon under Alternative 1, especially adult migration (Table 6.1-21). Water supply operations under Alternative 2A would slightly improve survival indices for adult migration and juvenile rearing life stages of fall- and spring-run Chinook salmon (Table 6.1-22). Although indices are reduced in some months, increased indices are more prevalent. For spawning and incubation, reduction in the survival indices occurs more frequently than increases. For spring-run Chinook salmon, the effect of reduced indices for spawning and incubation does not accurately reflect the conditions experienced within the spawning habitat. Most spring-run Chinook salmon spawn in the low-flow section of the Feather River upstream of Thermalito. Water temperatures in the low-flow section are cooler, and changes in operations under Alternative 2A would not be expected to alter water temperature or adversely affect spawning success of spring run. Given the relatively few months affected and small change, the reduction in the spawning and incubation indices for fall-run is likely to have a less-than-significant impact on survival. Improved conditions for adult migration and juvenile rearing may also ameliorate the slight effects on spawning and incubation.

Similar to the Feather River, suboptimal conditions occur in the American River during many months for life stages of fall-run Chinook salmon under Alternative 1 (Table 6.1-23). Water supply operations under Alternative 2A would slightly improve survival indices for adult migration, juvenile rearing, and smolt migration life stages of fall-run Chinook salmon (Table 6.1-24). Water supply operations under Alternative 2A would have a slight beneficial impact on water temperature conditions supporting fall-run Chinook salmon.

Table 6.1-21. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Feather River at Thermalito for Alternative 1, 1922–1994 Simulation

	Fall-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Base Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
1.0	176	345	418	175	143	140	742	573	371	271	736	391
0.9	45	16	10	32	48	9	59	2	56	26	77	32
0.8	19	11	3	5	45	8	29	0	19	14	26	5
0.7	24	7	1	2	49	7	9	1	18	11	12	2
0.6	27	13	0	2	47	12	10	0	28	6	5	2
0.5	26	7	0	0	40	7	3	0	8	9	5	0
0.4	16	5	0	0	22	6	3	0	2	3	2	0
0.3	18	9	0	0	22	9	2	0	0	2	0	0
0.2	14	3	0	0	15	4	4	0	1	6	0	0
0.1	11	0	0	0	13	0	1	0	0	4	0	0
0.0	56	16	0	0	60	158	2	0	1	152	1	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-22. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the Feather River below Thermalito for Alternative 2A, 1922–1993 Simulation (2001 Operations)

	Fall-Run Chinook Salmon				Spring-Run Chinook Salmon				Steelhead			
Change in the Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
<+0.4	1	0	0	0	1	0	1	0	0	0	0	0
<+0.3	4	0	0	0	4	0	0	0	0	0	2	0
<+0.2	7	2	1	1	9	2	5	0	3	0	2	1
<+0.1	51	10	3	6	57	10	41	1	12	6	36	6
0.0	306	405	427	201	359	334	781	574	458	493	795	417
>-0.1	54	10	1	8	64	9	28	1	28	5	24	8
>-0.2	7	1	0	0	8	1	3	0	3	0	4	0
>-0.30	0	2	0	0	0	2	2	0	0	0	1	0
>-0.4	1	1	0	0	1	1	2	0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-23. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the American River at Sunrise for Alternative 1, 1922–1993 Simulation (2001 Operations)

	Fall-Run Chinook Salmon				Steelhead			
Base Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
1.0	189	307	420	184	377	276	793	400
0.9	15	50	12	23	40	31	64	23
0.8	7	26	0	9	5	9	5	9
0.7	52	11	0	0	35	8	0	0
0.6	70	11	0	0	28	5	0	0
0.5	39	3	0	0	6	9	1	0
0.4	21	3	0	0	7	3	1	0
0.3	17	3	0	0	0	4	0	0
0.2	11	3	0	0	3	4	0	0
0.1	1	0	0	0	1	4	0	0
0.0	10	15	0	0	2	151	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-24. Frequency of Monthly Water Temperature Survival Indices for Chinook Salmon and Steelhead Life Stages in the American River at Sunrise for Alternative 2A, 1922–1993 Simulation

	Fall-Run Chinook Salmon				Steelhead			
Change in the Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
<+0.4	0	0	0	0	0	0	0	0
<+0.3	2	2	0	0	0	1	0	0
<+0.2	10	2	0	1	0	0	0	1
<+0.1	64	21	2	6	22	5	21	6
0.0	297	368	428	203	443	490	829	419
>-0.1	48	34	1	5	33	6	14	5
>-0.2	7	4	1	1	4	1	0	1
>-0.30	4	0	0	0	2	0	0	0
>-0.4	0	0	0	0	0	1	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Impact Fish-46: Operations-Related Increases in Entrainment-Related Losses of Fall-/Late Fall–Run Chinook Salmon from the San Joaquin River Basin. SWP and CVP pumping for Alternative 2A varies from pumping that was simulated for Alternative 1 (Figure 6.1-9). Increased pumping potentially increases entrainment-related losses of juvenile Chinook salmon from the San Joaquin River.

Under Alternative 1, annual losses of fall-run Chinook salmon vary from about 10,000 juveniles to 55,000 juveniles for the 73-year CALSIM simulated monthly CVP and SWP pumping (Figure 6.1-13). The simulated losses are based on the assumption that historical salvage densities and estimated losses are representative of losses that would occur in the future (Appendix J, "Methods for Assessment of Fish Entrainment in SWP and CVP Exports"). Most fall-run Chinook salmon entrainment losses historically have occurred during May. More than 90% of the fall-run Chinook salmon historically entrained by SWP and CVP pumping are believed to have originated from the San Joaquin River basin (California Department of Water Resources and Bureau of Reclamation 2001). Salvage of fall-run Chinook salmon at the CVP is more than twice the salvage at the SWP (Appendix J). Calculated loss of fall-run Chinook salmon at the SWP, however, is several times greater than the calculated loss for the CVP (San Joaquin River Group Authority 2003). The difference in loss is attributable to assumed high predation that occurs in CCF prior to salvage.

Entrainment losses generally increase under Alternative 2A, approaching a 20% increase in some years (i.e., total entrainment exceeding 60,000 juveniles) (Figure 6.1-13). To provide context for juvenile entrainment loss relative to the potential population abundance of juveniles, historical juvenile fall-run production from the San Joaquin River basin was estimated by the method applied by NOAA Fisheries for winter-run Chinook salmon (i.e., Winter Run JPE Estimator Program). Based on the method, production of juveniles from the San Joaquin River is estimated to range from about 180 thousand to more than 21 million fall-run juveniles (Appendix J). If an annual entrainment loss approaching 60,000 fish occurred during a year when production of juveniles is low (i.e., 180 thousand fish), the loss would represent as much as 33% of the annual production. The loss contributed by additional SWP pumping under Alternative 2A for such a year could approach 6% of the juvenile population. This would be the potential maximum impact from Alternative 2A. Because there is a potential for a substantial impact on the San Joaquin River juvenile Chinook production, this impact is considered to be significant.

The increased entrainment of juvenile Chinook salmon is attributable mostly to increased SWP pumping in May. Increased simulated pumping in May can occur in response to an increase in the permitted pumping criteria (i.e., from 6,680 cfs to 8,500 cfs) or in response to assumptions incorporated in CALSIM relative to the application of the EWA. The SDIP allows SWP pumping to increase from 6,680 cfs to 8,500 cfs when water is available or other criteria are not limiting in the second half of May. In the simulation of EWA by CALSIM, the EWA is assumed to be used to reduce pumping to protect fish during December through May. The EWA has a fixed water volume; therefore, when the available EWA water is used in the early months (beginning with December) and during VAMP, EWA water is no longer available to reduce SWP pumping in later months (e.g., May 16 through May 31). SWP pumping from May 16 through May 31 under Alternatives 2A increases relative to SWP pumping under

Alternative 1 (i.e., substantial increases in about 18% of the years—13 of the 73 years).

The impact of increased entrainment-related mortality (i.e., juvenile abundance would be reduced to a level that would affect population resilience and persistence) is assumed significant, even with the head of Old River gate closed in April and May. Increased entrainment-related losses may occur in response to increased pumping from May 16 through May 31. (The studies implemented as part of the VAMP are attempting to better understand potential relationships between salmon survival and streamflow, gate closure, and SWP and CVP pumping [San Joaquin River Group Authority 2003].) A substantial proportion of the annual juvenile production from the San Joaquin River may be affected during years with relatively low production. Also, a greater fraction of juvenile production may be entrained in years with relatively low San Joaquin River flow. Implementing Mitigation Measure Fish-MM-1 would reduce the significance of this impact to a less-than-significant level.

Mitigation Measure Fish-MM-1: Minimize Entrainment-Related Losses of Juvenile Fall-/Late Fall–Run Chinook Salmon from the San Joaquin River Basin That May Be Caused by Increased SWP Pumping from May 16 through May 31. The significant impact of increased entrainment-related mortality of juvenile Chinook salmon from the San Joaquin River is attributable to a simulated increase in SWP pumping from May 16 through May 31. This mitigation measure ensures that impacts on fall-run Chinook salmon from the San Joaquin River would be less than significant.

SWP pumping capacity in excess of 6,680 cfs will not be allowed from May 16 through May 31 if EWA actions are taken to reduce entrainment. The reduction in allowable SWP pumping above 6,680 cfs provided by DWR as mitigation will not exceed the reduction in pumping for fish protection provided by EWA. The reduction from 8,500 cfs to 6,680 cfs will not be charged to the EWA as long as the EWA action reduces export pumping by at least 1,820 cfs.

Substantial uncertainty surrounds the assessment and the significance determination for entrainment-related impacts on fall-run Chinook salmon from the San Joaquin River. Uncertainty is associated with the following assessment assumptions:

- Entrainment-related loss increases linearly with increased SWP and CVP pumping. (Alternative assumptions: Entrainment-related loss is asymptotic, and increased SWP pumping beyond the asymptote results in minimal additional loss, or entrainment losses increase at higher pumping.)
- Most of the entrainment-related losses attributable to the SWP pumping are related to predation on juvenile Chinook salmon in CCF. (Alternative assumptions: Predation in CCF is not a major contributor to entrainment-related losses; and the level of predation in CCF is similar to predation in Delta channels.)
- Although the head of Old River fish control gate prevents fish from moving into Old River and increases survival, additional net movement of San

Joaquin River flow into Turner Cut in response to increased SWP pumping increases entrainment-related mortality of juvenile Chinook salmon. (Alternative assumption: Net channel flow in Turner Cut, Old River, and Middle River does not affect survival of juvenile Chinook salmon in the San Joaquin River channel downstream of Stockton.)

- Entrainment-related mortality, including predation at the SWP and CVP pumping facilities, losses through the fish protection facilities, trucking and handling losses, and mortality attributable to SWP and CVP operations effects on channel flow conditions in the Delta, is sufficient to reduce juvenile abundance to a level that would affect population resilience and persistence. (Alternative assumption: Entrainment-related mortality and subsequent reduction in juvenile abundance would not affect population resilience and persistence.)

To help address these uncertainties, DWR and Reclamation will continue to support IEP and CALFED Science Program initiatives to better understand and quantify the actual entrainment-related losses at the CVP and SWP salvage facilities, and the efficacy of the head of Old River fish-control gate. This mitigation measure could be modified, as described under the adaptive management framework that is summarized at the end of the impact assessment section. This mitigation measure may be replaced by the long-term EWA if it is sufficient to operate from the Stage 2 permited SWP pumping basline.

Impact Fish-47: Operations-Related Increases in Entrainment-Related Losses of Chinook Salmon from the Sacramento River Basin. SWP and CVP pumping for Alternative 2A varies from pumping that was simulated for Alternative 1 (Figure 6.1-9). Change in pumping potentially alters entrainment and losses of juvenile Chinook salmon from the Sacramento River basin and the Mokelumne River.

Under Alternative 1, calculated annual losses of fall-run Chinook salmon vary from about 10,000 juveniles to 55,000 juveniles for the 73-year CALSIM simulated monthly CVP and SWP pumping (Figure 6.1-13). The simulated losses are based on the assumption that historical mean monthly salvage densities and estimated losses are representative of losses that would occur in the future (Appendix J, “Methods for Assessment of Fish Entrainment in SWP and CVP Exports”). Most fall-run Chinook salmon entrainment losses historically have occurred during May. More than 90% of the fall-run Chinook salmon historically entrained by SWP and CVP pumping are believed to have originated from the San Joaquin River basin (California Department of Water Resources and Bureau of Reclamation 2001); therefore, only about 10% of the historical entrainment losses would include fall-run Chinook salmon from the Sacramento River basin and the Mokelumne River.

Entrainment losses generally increase under Alternative 2A, approaching a 20% increase in some years (i.e., a total entrainment of Sacramento/Mokelumne fall-run Chinook salmon exceeding about 6,000 juveniles or about 10% of the 60,000 fish that includes fall-run juveniles from the San Joaquin River) (Figure 6.1-13). To provide context for juvenile entrainment loss relative to the potential population abundance of juveniles, historical juvenile fall-run production from the Sacramento River basin was estimated by the method applied by NOAA Fisheries for winter-run Chinook salmon (i.e., Winter Run JPE Estimator Program). Based on the method, production of juveniles from the Sacramento River is estimated to range between about 18 million to more than 208 million fall-run juveniles (Appendix J). If an annual entrainment loss approaching 6,000 fish occurred during a year when production of juveniles is low (i.e., 18 million fish), the loss would represent about 0.03% of the annual production. The loss contributed by additional SWP pumping under Alternative 2A for such a year could approach just 0.006% of the juvenile population. The simulated increase in entrainment-related losses would be small, and the proportion of annual fall-run production from the Sacramento River basin and the Mokelumne River lost to entrainment would be inconsequential, having a less-than-significant impact on the population.

Although late fall–run Chinook salmon from the Sacramento River basin are considered to be part of the fall-run Chinook salmon population, entrainment-related losses were assessed separately. Simulated annual losses of late fall–run Chinook salmon vary from about 400 juveniles to almost 1,600 juveniles (Figure 6.1-13). Similar to entrainment losses for fall run, entrainment losses generally increase under Alternative 2A, approaching or exceeding a 15% increase in some years. To provide context for juvenile entrainment loss relative to the potential population abundance of juveniles, production of juvenile late fall–run Chinook salmon is estimated to range between about 120 thousand to more than 8.8 million juveniles (Appendix J). If an annual entrainment loss approaching 1,600 fish occurred during a year when production of juveniles is low (e.g., 120 thousand fish), the loss would represent about 1% of the annual production. The loss contributed by additional SWP pumping under Alternative 2A for such a year could approach 0.2% of the juvenile population. As for fall run, the simulated increase in entrainment-related losses is relatively small, and the proportion of annual late fall–run production lost to entrainment would likely be inconsequential, having a less-than-significant impact on the population.

Simulated annual entrainment losses of winter-run Chinook salmon vary from about 1,000 juveniles to 5,000 juveniles (Figure 6.1-13). Entrainment losses generally increase under Alternative 2A, approaching or exceeding a 15% increase in some years (i.e., total entrainment exceeding 5,500 juveniles). An estimated 30 thousand to 5.5 million winter-run juveniles have possibly passed through the Delta in past years (Appendix J). Entrainment losses of 5,500 juveniles could exceed an estimated 18% of the total annual winter-run production. The loss contributed by additional SWP pumping under Alternative 2A for such a year could approach 3% of the juvenile population. Based on the observed proportion of the juvenile production for winter-run Chinook salmon that has been salvaged and lost to entrainment-related factors, it is unlikely that the actual proportion lost would exceed 2–5%, especially considering that entrainment losses to CVP and SWP pumping that likely exceed 2% of the annual production would result in reinitiation of consultation with NOAA Fisheries and implementation of measures to minimize losses (National Marine Fisheries Service 1995).

Additional SWP pumping, however, could increase entrainment-related losses of winter-run Chinook salmon and increase the frequency of reconsultation under existing biological opinions for operation of the SWP and CVP. The impact, therefore, is considered significant.

Simulated annual losses of spring-run Chinook salmon vary from about 6,000 juveniles to 35,000 juveniles (Figure 6.1-13). Entrainment losses generally increase under Alternative 2A, approaching or exceeding a 10% increase in some years (i.e., total entrainment exceeding 38,000 juveniles). Natural production of spring-run Chinook salmon entrained by SWP and CVP pumping includes fish from small tributary populations (e.g., Mill, Deer, and Butte Creeks) and populations in the Feather and Sacramento Rivers that may be genetically compromised by spawning with fall-run Chinook salmon. Consequently, the potential effect on the population of juveniles representing true spring-run Chinook salmon cannot be determined with available information. Considering that the natural production from tributary populations is relatively small (Appendix J), the impact of a 10% increase in entrainment loss is considered significant. Implementing Mitigation Measure Fish-MM-2 would reduce the significance of this impact to a less-than-significant level.

Mitigation Measure Fish-MM-2: Minimize Entrainment-Related Losses of Juvenile Winter- and Spring-Run Chinook Salmon That May Be Caused by Increased SWP Pumping from March 1 through April 14 and May 16 through May 31. The significant impact of increased entrainment-related mortality of juvenile winter- and spring-run Chinook salmon is attributable to a simulated increase in SWP pumping during March (winter run) and April–May (spring run). This mitigation measure ensures that impacts on winter- and spring-run Chinook salmon would be less than significant and includes the following components that build upon and integrate with Mitigation Measure Fish-MM-1:

SWP pumping capacity in excess of 6,680 cfs will not be allowed from March 1 through April 14 if EWA actions are taken to reduce entrainment. The reduction in allowable SWP pumping above 6,680 cfs provided by DWR as mitigation will not exceed the reduction in pumping for fish protection provided by EWA. The reduction from 8,500 cfs to 6,680 cfs will not be charged to the EWA as long as the EWA action reduces pumping by at least 1,820 cfs.

DWR and Reclamation will continue to support IEP and CALFED Science Program initiatives to better understand and quantify the actual entrainment-related losses at the CVP and SWP salvage facilities, and the efficacy of the DCC closure that is assumed to protect these Sacramento River fish. This mitigation measure could be modified, as described under the adaptive management framework that is summarized at the beginning of the impact assessment section above. This mitigation measure may be replaced by the long-term EWA if it is sufficient to operate from the Stage 2 permited SWP pumping basline.

Impact Fish-48: Operations-Related Reduction in Food Availability for Chinook Salmon. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for juvenile

Chinook salmon. Changes in water supply operations potentially affect prey habitat in the Sacramento, Feather, and American Rivers. The flow simulated for 1922–1994 in the Sacramento, Feather, and American Rivers for Alternative 2A varies relative to flow under Alternative 1 (Figure 6.1-5). The reduction in flow in some months and increases for other months and years has minimal effect on the range of flows that could affect rearing habitat area for juvenile Chinook salmon (Table 6.1-14) and would likely have minimal effect on habitat supporting prey organisms. The impact on food for Chinook salmon would be less than significant.

Inundated floodplain in the Yolo and Sutter Bypasses provides important access by fish to prey organisms and input of nutrients to the rivers and Delta (Sommer and Harrell et al. 2001). As previously discussed for juvenile Chinook salmon rearing habitat, the frequency of floodplain inundation in the Yolo and Sutter Bypasses was estimated under Alternative 1 for the 1922–1994 water years (Figure 6.1-10). Most flooding occurs from December though April, coinciding with downstream movement and rearing by juvenile Chinook salmon in all runs (Table 6.1-2). Changes in water supply operations under Alternative 2A could reduce flooding in November of one year for the Sutter Bypass and in December of two years for the Yolo Bypass. The reduced bypass flooding in November and December would have a less-than-significant impact on the expected access by juvenile Chinook salmon to prey organisms and input of nutrients to the rivers and Delta. The determination is based on several factors. Few months are affected, with inundation predicted in 143 months for the Sutter Bypass and 100 months for the Yolo Bypass (i.e., 1922–1994 simulation). In addition, the probability of flooding in months subsequent to the three affected months, and the subsequent availability of floodplain rearing habitat, is higher for January, February, and March. Therefore, access to the floodplain may be delayed but access to prey organisms and input of nutrients would likely be available in a subsequent month. No mitigation is required.

Coho Salmon

Effects of implementing Alternative 2A on coho salmon are discussed for the Trinity River (southern Oregon/northern California coasts' ESU). Gate construction and dredging activities occur in the Delta and would, therefore, not affect environmental conditions in the Trinity River or any life stages of anadromous fish species that occur in the Trinity River. Changes in water supply operations, however, may affect Trinity Reservoir storage and Trinity River flow. The following assessment identifies potential impacts of implementing the water supply operations under Alternative 2A. The environmental correlates addressed for coho salmon include spawning habitat quantity, rearing habitat quantity, migration habitat condition, water temperature, and food.

Effects on Chinook salmon, steelhead, and other species are not discussed for the Trinity River. The effects on coho salmon are representative of the potential effects on Chinook salmon and steelhead.

Impact Fish-49: Operations-Related Loss of Spawning Habitat Area for Coho Salmon in the Trinity River. Flow in the Trinity River under

Alternative 2A is nearly the same as flow under Alternative 1, with increased flow in a few months (Figure 6.1-4). The changes in flow would not adversely affect spawning habitat area in the Trinity River. This potential impact is considered less than significant. No mitigation is required.

Impact Fish-50: Operations-Related Loss of Rearing Habitat Area for Coho Salmon in the Trinity River. Flow in the Trinity River under Alternative 2A is nearly the same as flow under Alternative 1, with increased flow in a few months (Figure 6.1-4). The changes in flow would not adversely affect rearing habitat area in the Trinity River. This potential impact is considered less than significant. No mitigation is required.

Impact Fish-51: Operations-Related Decline in Migration Habitat Conditions for Coho Salmon in the Trinity River. Flow in the Trinity River under Alternative 2A is nearly the same as flow under Alternative 1, with increased flow in a few months (Figure 6.1-4). The changes in flow would not adversely affect migration habitat conditions in the Trinity River. This potential impact is considered less than significant. No mitigation is required.

Impact Fish-52: Operations-Related Reduction in Survival of Coho Salmon in Response to Changes in Water Temperature in the Trinity River. Simulated water temperature for the Trinity River is nearly the same for Alternative 1 and Alternative 2A (Figure 6.1-14), although warmer and cooler water temperatures occur in some months. (Note: Points that fall off of the 45º line in the figures for water temperature indicate warming [above the line] or cooling [below the line] relative to the No Action Alternative.) As indicated previously, changes in Trinity River flow are minimal and would not affect water temperature. The simulated changes in water temperature under Alternative 2A are caused by simulated changes in export of Trinity River water to the Sacramento River (Figure 6.1-15). Although the annual water volume exported to the Sacramento River is nearly the same under Alternative 1 and Alternative 2A, the monthly volume of Trinity River exports under Alternative 2A varies from the volume exported under Alternative 1.

Water exported to the Sacramento River is released from Trinity Reservoir to Lewiston Reservoir. Water in Lewiston Reservoir is either released to the Trinity River or exported to the Sacramento River. When Trinity Reservoir releases are low during warmer months, water traversing Lewiston Reservoir warms considerably prior to release to the Trinity River. Under Alternative 2A, the warming of water temperature in some months coincides with reduced export of Trinity River water and the cooling coincides with increased export.

Increased water temperature in the Trinity River during the fall months could have an adverse effect on coho salmon and other salmonids. Survival indices were assigned to the water temperature simulated for each month of occurrence for adult migration, spawning, juvenile rearing, and smolt migration life stages of coho salmon in the Trinity River. Water temperature conditions under Alternative 1 are optimal (an index of 1) for most months (Table 6.1-25). For all life stages, the water temperature survival indices are nearly the same for

Alternatives 1 and 2A (Table 6.1-26). The frequency of change in indices for adult migration show the most change, but only 8 months out of 288 simulated months of migration are affected, and the number of declines in the survival indices is similar to the number of increases. The shift in water temperature survival indices would not affect adult migration or other life stages. The change in water supply operations under Alternative 2A would not affect survival of coho salmon in the Trinity River. This potential impact is less than significant. No mitigation is required.

Table 6.1-25. Frequency of Monthly Water Temperature Survival Indices for Coho Salmon (i.e., Based on Criteria for Chinook Salmon) in the Trinity River at Lewiston for Alternative 1, 1922–1994 Simulation

	Coho Salmon			
Base Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
1.0	277	288	862	288
0.9	6	0	2	0
0.8	3	0	0	0
0.7	0	0	0	0
0.6	0	0	0	0
0.5	0	0	0	0
0.4	1	0	0	0
0.3	0	0	0	0
0.2	0	0	0	0
0.1	1	0	0	0
0.0	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Table 6.1-26. Frequency of Monthly Water Temperature Survival Indices for Coho Salmon Life Stages in the Trinity River at Lewiston for Alternative 2A, 1922–1993 Simulation (2001 Operations)

	Coho Salmon			
Change in the Index	Adult Migration	Spawning/ Incubation	Juvenile Rearing	Smolt Migration
<+0.4	0	0	0	0
<+0.3	0	0	0	0
<+0.2	0	0	0	0
<+0.1	4	0	1	0
0.0	280	288	860	288
>-0.1	3	0	3	0
>-0.2	1	0	0	0
>-0.30	0	0	0	0
>-0.4	0	0	0	0

Note: See Table 6.1-2 to identify months for each life stage.

Impact Fish-53: Operations-Related Reduction in Food Availability for Coho Salmon in the Trinity River. Flow in the Trinity River under Alternative 2A is nearly the same as flow under Alternative 1, with increased flow in a few months (Figure 6.1-4). The changes in flow would not adversely affect food abundance or availability for coho salmon in the Trinity River.

Steelhead

The following assessment identifies potential impacts of operating Alternative 2A on Central Valley steelhead. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages. Environmental correlates addressed for steelhead include spawning habitat quantity, rearing habitat quantity, migration habitat condition, water temperature, food, and entrainment in diversions.

Impact Fish-54: Operations-Related Loss of Spawning Habitat Area for Steelhead. Steelhead spawn in the cool reaches of the Sacramento, Feather, and American Rivers downstream of the terminal reservoirs. Changes in water supply operations potentially affect spawning habitat area for steelhead. The spawning and egg incubation period for steelhead extends from December through June.

Flows simulated for Alternative 1 provide near the maximum spawning habitat area during the months of spawning in the Sacramento and Feather Rivers (Table 6.1-8). Change in Sacramento and Feather River flows attributable to water supply operations under Alternative 2A would not affect spawning habitat area (Table 6.1-13). In the American River, spawning habitat area for steelhead is not affected during most months (Table 6.1-13) but is less abundant in a few months. The reduction in area is generally less than 10% and does not affect spawning for all months in any year. Given the few spawning months affected and the relatively small change in spawning habitat area, the effect on adult spawning success and survival of steelhead eggs and larvae through incubation in the American River would be less than significant. No mitigation is required.

Impact Fish-55: Operations-Related Loss of Rearing Habitat Area for Steelhead. Changes in water supply operations potentially affect rearing habitat area for steelhead in the Sacramento, Feather, and American Rivers. Rearing occurs year round in the cool reaches below the terminal reservoirs. The flow simulated for 1922–1994 in the Sacramento, Feather, and American Rivers for Alternative 2A varies relative to flow under Alternative 1 (Figure 6.1-5). The reduction in flow in some months and increases for other months and years has minimal effect on the range of flows that could affect rearing habitat area (Table 6.1-14). The impact on steelhead would be less than significant because rearing habitat in most months of most years is unaffected. No mitigation is required.

Impact Fish-56: Operations-Related Decline in Migration Habitat Conditions for Steelhead. The Sacramento, Feather, and American Rivers provide a migration pathway between freshwater and marine habitats for steelhead. Flows that occur in Central Valley rivers generally support migration of adult and juvenile steelhead. Relative to Alternative 1, flows under Alternative 2A are within the range of flows under Alternative 1 and would not affect migration of adult and juvenile steelhead in Central Valley rivers (Figures 6.1-4 and 6.1-5).

In the Delta, juvenile Chinook salmon survival is lower for fish migrating through the central Delta than for fish continuing down the Sacramento River channel (Brandes and McLain 2001; Newman and Rice 1997). A similar relationship is assumed for juvenile steelhead. Juvenile steelhead begin entering the Delta from upstream habitat in the Sacramento River and its tributaries during December. Downstream movement and migration continues through May or June. Few juvenile steelhead move through the Delta from July through November.

Juvenile steelhead are assumed to move along Delta channel pathways in proportion to flow; therefore, an increase in the proportion of flow diverted off the Sacramento River through the DCC and Georgiana Slough would be expected to increase mortality of migrating juvenile steelhead. The proportion of Sacramento River flow diverted into the DCC and Georgiana Slough under Alternative 2A is generally the same as the proportion diverted for Alternative 1 (Figure 6.1-7), especially during the primary period of juvenile steelhead migration (Table 6.1-2). For the primary migration period, the change in flow is usually less than 1% (Figure 6.1-7). Operations under Alternative 2A would have a less-than-significant impact on survival of juvenile steelhead migrating from the Sacramento River because the proportion of flow diverted off the Sacramento River at the DCC and Georgiana Slough is similar to the proportion of flow diverted under Alternative 1.

For the San Joaquin River, the flow split at the head of Old River determines the pathway of juvenile fall-run Chinook salmon through the south Delta. Available data indicate that survival for fish continuing down the San Joaquin River past Stockton is higher than survival of fish that move into Old River (San Joaquin River Group Authority 2003; Brandes and McLain 2001). Effects on steelhead are assumed to be similar to effects on juvenile Chinook salmon. As described for Chinook salmon, flow and pumping changes under Alternative 2A would have minimal effect on survival of juvenile steelhead.

Impact Fish-57: Operations-Related Reduction in Survival of Steelhead in Response to Changes in Water Temperature. Change in reservoir storage and river flow potentially affects water temperature in the Sacramento, Feather, and American Rivers. Water temperature in river reaches immediately downstream of the primary reservoirs, including Shasta, Oroville, and Folsom, are the most sensitive to effects of operations. These reaches support steelhead life stages that can be adversely affected by temperature conditions in Central Valley rivers.

Water temperatures in the Sacramento, Feather, and American Rivers are similar under Alternative 1 and Alternative 2A (Figures 6.1-11 and 6.1-12). The change in water temperature attributable to Alternative 2A is almost always less than 1°F (0.56°C), although larger changes occur in some simulated months. The magnitude and frequency of changes are too small and too infrequent to attribute to any specific SDIP action. The potential effect of water temperature on steelhead life stages warrants further consideration of the range of water temperatures affecting survival. Survival indices were assigned to the water temperatures for each month of occurrence of each life stage for steelhead in the Sacramento, Feather, and American Rivers.

For all life stages in the Sacramento River near Keswick, the water temperature survival indices are near optimal in most months under Alternative 1 (Table 6.1-15). The indices are similarly high at Bend Bridge and RBDD (Tables 6.1-16 and 6.1-17), although less than optimal indices for spawning and incubation are more frequent for spawning and incubation at RBDD. The occurrence of lower indices reflects warming of water temperatures downstream from Keswick and Bend Bridge.

The few months of change in survival indices at Keswick under Alternative 2A illustrate the similarity to indices under Alternative 1 (Table 6.1-18). The infrequent change in the indices would have a less-than-significant impact on survival. At Bend Bridge and RBDD, change in the survival indices under Alternative 2A is slightly more frequent than occurred at Keswick (Tables 6.1-19 and 6.1-21). Water temperature conditions supporting spawning and incubation improve in some months. Other than the benefit to spawning and incubation at Bend Bridge and RBDD, water temperature survival indices for steelhead life stages in the Sacramento River are nearly the same under Alternative 1 and Alternative 2A.

In the Feather River, suboptimal conditions occur during many months for most life stages under Alternative 1, especially adult migration and juvenile rearing (Table 6.1-21). Water supply operations under Alternative 2A would slightly improve survival indices for juvenile rearing (Table 6.1-22). Although indices are reduced in some months, increased indices are more prevalent. For other life stages, relatively few months are affected and changes are small. Change in water temperature would have a less-than-significant impact on survival. No mitigation is required.

Similar to the Feather River, suboptimal conditions occur in the American River during many months for adult migration and juvenile rearing under Alternative 1 (Table 6.1-23). Water supply operations under Alternative 2A would slightly improve survival indices for juvenile rearing (Table 6.1-24). Water supply operations under Alternative 2A would have minimal effects on water temperature conditions supporting steelhead.

Impact Fish-58: Operations-Related Increases in Entrainment Losses of Steelhead. Under Alternative 1, simulated SWP and CVP pumping would result in an estimated annual salvage of approximately 1,000 to 4,500 juvenile steelhead (Figure 6.1-16). Salvage, and hence entrainment losses, generally increase under Alternative 2A, approaching a 15–20% increase in some years (i.e., total salvage exceeding 4,900 juveniles). The proportion of annual steelhead production entrained is currently unknown, but the effect on steelhead from the Sacramento River basin would likely be similar to effects described for spring-run Chinook salmon. Effects of increased SWP pumping on steelhead from the San Joaquin River basin would likely be similar to effects on fall-run Chinook salmon from the San Joaquin River basin. Juvenile steelhead are larger than juvenile Chinook salmon; therefore, entrainment-related losses of juvenile steelhead may be less than the effects described for juvenile Chinook salmon. The larger size results in higher screening efficiency and may increase the ability of individuals to avoid predators. However, considering that the natural production of steelhead appears to be relatively low, the potential impact of a 15–20% increase in entrainment loss in some years is considered significant. Mitigation measures Fish-MM-1 and Fish-MM-2, already described for reducing Chinook entrainment, would reduce the impact to less than significant.

Impact Fish-59: Operations-Related Reduction in Food Availability for Steelhead. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for steelhead. Changes in water supply operations potentially affect prey habitat in the Sacramento, Feather, and American Rivers. The flow simulated for 1922–1994 in the Sacramento, Feather, and American Rivers for Alternative 2A varies relative to flow under Alternative 1 (Figure 6.1-5). The reduction in flow in some months and increases for other months have minimal effect on the range of flows that could affect rearing habitat area for steelhead (Table 6.1-14) and would likely have minimal effect on habitat supporting prey organisms. The impact on food for steelhead would be less than significant. No mitigation is required.

Delta Smelt

The following assessment identifies potential impacts of implementing Alternative 2A on delta smelt. Delta smelt occur primarily within the Delta and Suisun Bay, with sporadic occurrence in San Pablo Bay and frequent occurrence in the Napa River estuary. Delta smelt do not occur in the rivers upstream of the Delta. The environmental conditions within the Delta and Suisun Bay that could be affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages. Environmental correlates addressed for delta smelt include spawning habitat quantity, rearing habitat quantity, migration habitat condition, food, and entrainment in diversions.

Impact Fish-60: Operations-Related Loss of Spawning Habitat Area for Delta Smelt. Delta smelt spawn in the Delta, upstream of the 2 ppt isohaline (X2). As indicated in the methods description, existing information does not indicate that spawning habitat is limiting population abundance and production (U.S. Fish and Wildlife Service 1996). The extent of salinity intrusion into the Delta, as represented by the change in location of X2, provides an index of potential effects of water supply operations on spawning habitat availability throughout the Delta. Delta smelt spawn primarily from January through May. Water supply operations under Alternative 2A would affect the location of X2 (Figure 6.1-8). The location of X2 during the spawning period for delta smelt is nearly the same under both Alternative 1 and 2A. The change in location of X2 during the spawning period is less than 1 kilometer in most months, indicating relatively minor salinity intrusion into Delta spawning areas. Operations under Alternative 2A would have a less than significant impact on spawning habitat in the Delta.

Impact Fish-61: Operations-Related Loss of Rearing Habitat Area for Delta Smelt. Delta smelt larvae, juveniles, and adults rear in the Delta and Suisun Bay where changes in water supply operations potentially affect estuarine rearing habitat area. The location of the preferred salinity range for delta smelt rearing is assumed to determine estuarine rearing habitat area in the Delta and Suisun Bay. The range of salinity preferred by delta smelt (0.3 ppt to 1.8 ppt) was used to calculate the estuarine rearing habitat area for each month under Alternative 1 (proportion of the maximum area available for any month of the 1922–1994 simulation) (Figure 6.1-17). High Delta outflows move X2 downstream and increase the available rearing habitat for Delta smelt. The proportion of the maximum rearing habitat area available ranged from about 25% to 100% depending on the month and simulated hydrologic conditions. The primary months that estuarine rearing habitat is important to survival of a year class are not precisely known, but it appears to be most important from March through July (Unger 1994). During most simulated years, the proportion of maximum habitat area available exceeded 60% during the important months for rearing in most years. Habitat availability is generally lowest from September through December (Figure 6.1-17).

Compared to Alternative 1, the change in estuarine rearing habitat area attributable to water supply operations under Alternative 2A is small (generally less than 5%) and infrequent for most years during all months. Most of the time, rearing habitat area is the same for Alternative 1 and Alternative 2A. Given the few rearing months affected and the relatively small change in estuarine rearing habitat area, effects on survival of delta smelt would be less than significant. No mitigation is required.

Impact Fish-62: Operations-Related Decline in Migration Habitat Conditions for Delta Smelt. Water supply operations under Alternative 2A would change SWP and CVP pumping and Delta inflow and outflow (Figures 6.1-6 and 6.1-9). Net flow in the Delta channels could be affected (Section 5.2, Delta Tidal Hydraulics). Although net channel flows have been identified as important because they move fish downstream (U.S. Fish and Wildlife Service 1996), actual effects of net flow changes on the movement of adult, larvae, and juvenile delta smelt have not been demonstrated. Given that net flow changes attributable to water supply operations are small relative to tidal flows, effects on delta smelt migration habitat are considered less than significant.

Impact Fish-63: Operations-Related Increases in SWP Pumping and Resulting Entrainment Losses of Delta Smelt. Under Alternative 1, simulated SWP and CVP pumping results in annual estimated salvage ranging from about 7,000 to 35,000 delta smelt (Figure 6.1-19). Most delta smelt (about 90%) are salvaged during May–June (Appendix J). However, adult delta smelt are entrained in small numbers through the winter and early spring months of November through March. Salvage generally increases under Alternative 2A, approaching a 15–40% increase in some years (Figure 6.1-19). The increased salvage is primarily attributable to increased SWP pumping in June (Figure 6.1-20), although increased pumping also contributes to increased entrainment in May and July. The increased pumping under Alternative 2A in the winter and early spring months of November–March has a potentially large impact on the population because these delta smelt are adults moving into spawning habitat.

Gate closure causes additional net flow to be drawn from the San Joaquin River and south through Old River, Middle River, and Turner Cut (Section 5.2, Delta Tidal Hydraulics). The increased net flow toward the south may increase entrainment of larval and juvenile delta smelt (Appendix J). The effects of gate closure are similar for Alternatives 1 and 2A, but the fish control gate constructed under Alternative 2A would be closed from April 1 through May 31. During the May–July period, salvage consists mostly of 0.79–1.18-inch (20–30-mm) juveniles (Figure 6.1-21). Based on the 20-mm survey data, most juvenile smelt occur in Suisun Bay and near the confluence of the Sacramento and San Joaquin Rivers during April–July. However, a substantial proportion of the population may occur within the central and south Delta. Delta smelt larvae and juveniles within the central and south Delta are vulnerable to entrainment by SWP and CVP pumping. An increase in salvage ranging from 15% to 35% may represent substantial but unknown proportions of the annual larval and juvenile production. Given the limited understanding of smelt abundance and distribution and of factors affecting the population abundance, the impact of increased SWP pumping in the winter and early spring months of November–March when adult delta smelt are in relatively high densities, as well in as May and June, when the delta smelt salvage density is highest, is considered significant. Implementing Mitigation Measure Fish-MM-3 would reduce this impact to a less-than-significant level.

Mitigation Measure Fish-MM-3: Minimize Entrainment Losses of Delta Smelt Associated with Increased SWP Pumping. The significant impact of increased entrainment-related mortality of delta smelt is attributable primarily to a potential increase in SWP pumping during May and June. Entrainment of adult delta smelt in the winter may also be significant. This mitigation measure ensures that the impact of increased SWP pumping on delta smelt would be reduced to a less than significant level and includes the following components that build upon and integrate with Mitigation Measures Fish-MM-1, and Fish-MM-2:

1. SWP pumping capacity in excess of 6,680 cfs will not be allowed from November 1 through June 30 if EWA actions are taken to reduce entrainment. Fish-MM-1 already provides mitigation for the May 16–May 31 period and Fish-MM-2 provides mitigation for the March 1–April 14 period. The reduction in allowable SWP pumping above 6,680 cfs provided by DWR as mitigation will not exceed the reduction in pumping for fish protection provided by EWA. The reduction from 8,500 cfs to 6,680 cfs (or the existing pumping limit in the December 15–March 15 period) will not be charged to the EWA, as long as the EWA reduction is at least as large.
2. From November 1 through March 31, pumping-reduction credits will be given to the EWA (ranging from 10% to up to 30%) for all non-EWA pumping that is above the existing permitted capacity. Under this mitigation component, for each 100 taf of non-EWA pumping above the existing permitted capacity, a pumping reduction credit, ranging from 10 taf to 30 taf, could be used by EWA to reduce pumping during periods of high fish density.

This relatively simple avoidance of impacts during periods of EWA actions, in addition to an EWA credit for mitigation of periods with remaining pumping above the existing permitted capacity, will reduce the delta smelt entrainment impacts to less than significant. DWR and Reclamation will coordinate with DFG, NOAA Fisheries, and USFWS to determine the appropriate credit percentage.

When an expanded EWA (i.e., greater than CALFED ROD EWA) is implemented by CALFED, as assumed in the 2004 OCAP documents, this SDIP mitigation measure would no longer be required because the expanded EWA is assumed to be sufficient to mitigate any entrainment impacts from the incremental pumping above the existing permitted capacity. The SWP has proposed increased funding through an amended Four-Pumps Agreement to support SDIP mitigation measures, including an expanded EWA. In the absence of the EWA, that increased funding would continue to be available to DFG to mitigate impacts of the SDIP through purchases of water to reduce pumping during critical periods for fish or other mitigation strategies developed through the adaptive management process.

DWR and Reclamation will continue to support IEP and CALFED Science Program initiatives to better understand and quantify the actual entrainment-related losses at the CVP and SWP salvage facilities, improved salvage techniques for delta smelt, and the effects of the head of Old River fish control gate on the movement of relatively high densities of delta smelt from the vicinity of Franks Tract. This mitigation measure could be modified, as described under the adaptive management framework that is summarized at the beginning of the impact assessment section above, utilizing in whole or in part, increased funds available through the Four-Pumps Agreement.

Impact Fish-64: Operations-Related Reduction in Food Availability for Delta Smelt. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for delta smelt. As discussed above for rearing habitat area, changes in water supply operations potentially affect estuarine rearing habitat area for delta smelt in the Delta and Suisun Bay. Location of rearing habitat area downstream of the Delta is believed to increase food availability for delta smelt (U.S. Fish and Wildlife Service 1996). The broad and shallow areas of Suisun Bay allow algae to grow and reproduce rapidly, providing food for zooplankton, which are food for delta smelt. Greater rearing habitat area for delta smelt coincides with location downstream of the Delta and within the areas of higher zooplankton production. The change in estuarine rearing habitat area under Alternative 2A is small (generally less than 5%) and infrequent for most years during all months (Figure 6.1-18). Given the few rearing months affected, especially during April through August, and the relatively small change in estuarine rearing habitat area, the impact on food availability for delta smelt would be less than significant.

Delta smelt feed on zooplankton; consequently prey organisms may be subject to entrainment effects similar to those described above for larval and juvenile delta smelt within the central and south Delta. Entrainment loss of food organisms and its effect on delta smelt productivity is currently unknown. The effect, however, is not clearly separable from entrainment loss of delta smelt. The impact of entrainment on food is assumed to be encompassed by the impact described for delta smelt (Impact Fish-63). Mitigation Measure Fish-MM-3 would reduce the entrainment impacts on food organisms for delta smelt to less than significant.

Splittail

The following assessment identifies potential impacts of operating Alternative 2A on splittail. Splittail are dependent on conditions upstream of the Delta for rearing and spawning, especially inundated floodplain in the Yolo and Sutter Bypasses. Adult and juvenile splittail spend most of their lives in the Delta and Suisun Bay. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages. Environmental correlates addressed for splittail include spawning habitat quantity, rearing habitat quantity, migration habitat condition, food, and entrainment in diversions.

Impact Fish-65: Operations-Related Loss of Spawning Habitat Area for Splittail. The extent of salinity intrusion into the Delta, as represented by the change in location of X2, provides an index of potential effects of water supply operations on spawning habitat availability throughout the Delta. Splittail spawn primarily from February through May. Water supply operations under Alternative 2A would affect the location of X2 (Figure 6.1-8). The location of X2 during the spawning period for splittail is nearly the same under Alternative 1. The change in location of X2 during the spawning period is generally less than 1 kilometer, indicating relatively minor intrusion into Delta spawning areas. Operations under Alternative 2A would result in a less than significant impact on spawning habitat in the Delta.

Splittail spawn primarily upstream of the Delta and use vegetated areas on inundated floodplain or along the edge of the river channel (Sommer and Harrell et al. 2001). Inundated floodplain in the Yolo and Sutter Bypasses provides important spawning habitat for splittail. Changes in water supply operations affect reservoir storage and may affect the frequency of floodplain inundation. Inundation of the Yolo Bypass has occurred in one or more months of approximately 60% of the historical water years (Sommer and Harrell et al. 2001) and inundation of the Sutter Bypass occurs in at least 80% of historical water years. Monthly average flows provide an indicator of inundation, although weekly and shorter storm events that inundate floodplain are not captured by the simulated monthly average. The frequency of floodplain inundation in the Yolo and Sutter Bypasses was estimated under Alternative 1 for the 1922–1994 water years (Figure 6.1-10). Most flooding occurs from December though April, coinciding with the spawning period for splittail (Table 6.1-2). Changes in water supply operations under Alternative 2A could reduce flooding in November of one year for the Sutter Bypass and in December of two years for the Yolo Bypass. The reduced bypass flooding in November and December precedes the spawning period for splittail and would not affect spawning. Few months are affected, with inundation predicted in 143 months (i.e., 39% of the simulated months from December through April) for the Sutter Bypass and 100 months (i.e., 27% of the simulated months from December through April) for the Yolo Bypass (1922–1994 simulation). The probability of flooding in months subsequent to the three affected months, and the availability of floodplain spawning habitat in January, February, and March would not be affected. No mitigation is required.

Impact Fish-66: Operations-Related Loss of Rearing Habitat Area for Splittail. Inundated floodplain in the Yolo and Sutter Bypasses provides important rearing habitat for larval and juvenile splittail (Sommer et al. 1997). As discussed above for spawning habitat area, changes in water supply operations under Alternative 2A could reduce flooding in November of one year for the Sutter Bypass and in December of two years for the Yolo Bypass. The affected months precede the rearing habitat need for larval and juvenile splittail, although less floodplain inundation in December could affect rearing of adult splittail. The impact on splittail rearing, however, would be less than significant. The determination is based on several factors. Few months are affected, with inundation predicted in 143 months for the Sutter Bypass and 100 months for the

Yolo Bypass (1922–1994 simulation). The affected months are early in the period of upstream migration for adults. In addition, floodplain rearing habitat is not affected in the primary period of observed adult migration in January through March. Access to floodplain habitat may be delayed, but habitat would not be affected in the primary months.

Impact Fish-67: Operations-Related Decline in Migration Habitat Conditions for Splittail. The Sacramento River provides a migration pathway between freshwater and estuarine habitats for splittail. Flows that occur in the Sacramento River generally support migration of adult splittail. As indicated above for spawning and rearing habitat area, change in floodflows attributable to water supply operations under Alternative 2A would be early in the period of adult migration and affect few months. Relative to Alternative 1, the change in flows under Alternative 2A would not be expected to affect migration of adult and juvenile splittail. This impact is less than significant. No mitigation is required.

Impact Fish-68: Operations-Related Increases in Entrainment Losses of Splittail. Under Alternative 1, simulated CVP and SWP pumping results in annual salvage of splittail ranging from about 15,000 to 75,000 individuals (Figure 6.1-22). Highest salvage densities occur during May and June (Appendix J, "Methods for Assessment of Fish Entrainment in SWP and CVP Exports"). The median length of splittail salvaged during May and June is 1.97 inches (50 mm) or less (Figure 6.1-23), indicating entrainment of juveniles originating from spawning during the current year. High salvage coincides with high juvenile abundance during wet years (U.S. Fish and Wildlife Service 1995).

Salvage generally increases under Alternative 2A, approaching a 40% increase in one year and 10–20% increases in other years (Figure 6.1-22). Total salvage under Alternative 2A exceeds 70,000 juveniles for some wetter years. The increased salvage is attributable to increased SWP pumping. However, the largest percentage increase is associated with low pumping and low salvage (e.g., about 20,000 individuals).

Although entrainment may increase under Alternative 2A, the impact of entrainment on splittail abundance is determined to be less than significant. The conclusion is based on two factors. The largest percentage increase in simulated salvage occurs in dry and critically dry years, resulting in an overestimate of the potential increase given that the actual density of juvenile splittail would be less than the median value applied in the assessment method for entrainment. Also, most splittail spawn and rear over floodplain inundated by the Sacramento River, including the Yolo and Sutter Bypasses (Sommer et al. 1997). Substantial spawning in the San Joaquin River basin has appeared to coincide with high spawning success in the Sacramento River basin. Given that most splittail enter the Delta from the Sacramento River system and move into Suisun Bay and Marsh, the exposure to entrainment by SWP and CVP pumping would be relatively low relative to the total production of splittail. Information to determine the population level impact is not available. No mitigation is required.

Impact Fish-69: Operations-Related Reduction in Food Availability for Splittail. Inundated floodplain in the Yolo and Sutter Bypasses provides important access by fish to prey organisms and input of nutrients to the rivers and Delta (Sommer and Harrell et al. 2001). As previously discussed for splittail rearing habitat, changes in water supply operations under Alternative 2A would have little effect on access to floodplain rearing habitat during the primary period of splittail occurrence or on input of nutrients with runoff from floodplain habitat. This impact is considered less than significant. No mitigation is required.

Striped Bass

The following assessment identifies potential impacts of operating Alternative 2A on striped bass. Striped bass occur within the Delta, Suisun Bay, San Francisco Bay, and in the coastal waters near the San Francisco Bay. Adult striped bass migrate upstream in the Sacramento River to spawn. Some juvenile and adult striped bass occur in rivers upstream of the Delta throughout the year. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages. Environmental correlates addressed for striped bass include spawning habitat quantity, rearing habitat quantity, migration habitat condition, food, and entrainment in diversions.

Impact Fish-70: Operations-Related Loss of Spawning Habitat Area for Striped Bass. Striped bass spawn in the Delta and in the Sacramento River upstream of the Delta (California Department of Fish and Game 1987). Eggs are released into the water column. They are semibuoyant and drift with the currents. Eggs spawned in the Sacramento River drift downstream to the Delta. Larvae and early juveniles rear near the 2 ppt isohaline in the lower Delta and, depending on salinity conditions, Suisun Bay. Spawning in the Sacramento River upstream of the Delta occurs during May and June. Spawning in the Delta occurs during April and May, usually within the San Joaquin River channel between Antioch and Venice Island (California Department of Fish and Game 1987).

The extent of salinity intrusion into the Delta, as represented by the change in location of X2 (Figure 6.1-8), provides an index of potential effects of water supply operations on spawning habitat availability in the San Joaquin River. The location of X2 during the spawning period for striped bass is nearly the same under Alternatives 1 and 2A. The change in location of X2 is less than 1 kilometer, indicating relatively little intrusion into Delta spawning habitat under Alternative 2A. Water supply operations under Alternative 2A would have a less-than-significant impact on spawning habitat in the Delta. No mitigation is required.

Impact Fish-71: Operations-Related Loss of Rearing Habitat Area for Striped Bass. Striped bass larvae, juveniles, and adults rear in the Delta and Suisun Bay. Changes in water supply operations potentially affect estuarine rearing habitat area for striped bass in the Delta and Suisun Bay. The location of the preferred salinity range for striped bass is assumed to determine estuarine rearing habitat area in the Delta and Suisun Bay. The range of salinity preferred by striped bass larvae and early juveniles (i.e., 0.1 ppt to 2.5 ppt) was used to calculate the estuarine rearing habitat area for each month under Alternative 1 (i.e., proportion of the maximum area available for any month of the 1922–1994 simulation) (Figure 6.1-24). Proportional rearing habitat area ranged from about 40% to 100% depending on the month. The primary months that estuarine rearing habitat is important to survival of a year class are not precisely known, but it appears to be most important from April through June (Unger 1994). During most simulated years, the proportional habitat area exceeded 80% during April–June (Figure 6.1-24).

The change in estuarine rearing habitat area under Alternative 2A is small (generally less than 5%) relative to area under Alternative 1 (Figure 6.1-25). Given the few rearing months affected during April–June, and the relatively small change in estuarine rearing habitat area, effects on survival of striped bass would be less than significant. No mitigation is required.

Impact Fish-72: Operations-Related Decline in Migration Habitat Conditions for Striped Bass. Water supply operations could affect Sacramento River flow and survival of striped bass eggs and larvae (California Department of Fish and Game 1992). Higher flows (greater than 17,000 cfs) appear to result in higher egg survival. The mechanism for higher survival could be related to duration of transport, larval food availability, suspension of eggs within the water column, or other factors. Simulated Sacramento River flow under Alternative 2A for May and June would be similar to flow under Alternative 1. Notable reductions in flow occur in three months of the 1922–1994 May–June simulation (i.e., flow is reduced by more than 1,000 cfs). Affected flows under Alternative 1 range from 11,779 cfs to 14,264 cfs. The reduction in Sacramento River flow would have a less-than-significant impact on egg movement and survival in the Sacramento River because few years are affected and the flow changes are within the range of flows that do not clearly support higher egg survival. No mitigation is required.

Impact Fish-73: Operations-Related Increases in SWP Pumping and Resulting Entrainment Losses of Striped Bass. Under Alternative 1, simulated CVP and SWP pumping result in an estimated annual salvage of striped bass ranging from about 1 million to 7 million individuals (Figure 6.1-26). Salvage generally increases under Alternative 2A, approaching a 10–20% increase or more in some years (Figure 6.1-26). The increased salvage is attributable to increased simulated SWP pumping during June and July. Salvage in June and July, however, consists primarily of juveniles 20–30 mm in length (Figure 6.1-27), indicating that substantial entrainment of eggs and larvae could also occur in April and May.

Recent analysis of striped bass data sets indicates that entrainment of striped bass by SWP and CVP pumping is unrelated to total mortality rates and probably did not contribute to the observed decline in adult abundance (Kimmerer et al. 2001). However, the proportion of annual striped bass production lost to entrainment could be substantial and effects on future population abundance are currently unknown. The impact of increased SWP pumping in April, May, and June, therefore, is considered significant. Implementation of Mitigation Measures Fish-MM-1, Fish-MM-2, and Fish-MM-3 would reduce this impact to a less-than-significant level.

Impact Fish-74: Operations-Related Reduction in Food Availability for Striped Bass. Effects on food are the same as described for delta smelt. This impact is significant and would be reduced to a less-than-significant level by implementing Fish-MM-3 for delta Smelt, as discussed above.

Green Sturgeon

The following assessment identifies potential operations-related impacts of implementing Alternative 2A on green sturgeon in the Sacramento River and the Delta. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages. Environmental correlates addressed for green sturgeon include spawning habitat quantity, rearing habitat quantity, migration habitat condition, water temperature, food, and entrainment in diversions.

Impact Fish-75: Operations-Related Loss of Spawning Habitat Area for Green Sturgeon. Green sturgeon spawn in the cool, upper reaches of the Sacramento River, and possibly in the Feather River downstream of Oroville Dam. Changes in water supply operations potentially affect spawning habitat area for green sturgeon in the Sacramento and Feather Rivers. The spawning and egg incubation period for green sturgeon extends from late spring to early summer.

Change in Sacramento River flow attributable to water supply operations under Alternative 2A would not affect spawning habitat area for green sturgeon because the change in flow would not affect the existing area of deep pool habitat in the Sacramento River. This determination is based on the results of simulations of effects on spawning habitat area for Chinook salmon. Because Chinook salmon spawning habitat (which occurs in shallower habitats than green sturgeon spawning habitat) would not be reduced under Alternative 2A, it is reasonable to conclude that spawning habitat area for green sturgeon (which spawn in deep pools with fast water), also would not be affected. Similarly, change in Feather River flow attributable to water supply operations under Alternative 2A would not affect spawning habitat area for green sturgeon in the Feather River for the same reasons. This impact is less than significant. No mitigation is required.

Impact Fish-76: Operations-Related Loss of Rearing Habitat Area for Green Sturgeon. Changes in water supply operations potentially affect rearing habitat area for green sturgeon in the Sacramento and possibly the Feather Rivers, and move down into the Delta and San Pablo Bay during summer.

The flow simulated for 1922–1994 in the Sacramento and Feather Rivers for Alternative 2A varies relative to flow under Alternative 1 (Figure 6.1-5). The reduction in flow in some months and increases for other months and years have minimal effect on the range of flows that could affect rearing habitat area (Table 6.1-14). The impact on green sturgeon of any run would be less than significant.

Impact Fish-77: Operations-Related Decline in Migration Habitat Conditions for Green Sturgeon. The Sacramento River provides a migration pathway between freshwater and estuarine habitats for green sturgeon. Flows that occur in the Sacramento River generally support migration of adult sturgeon. Flows under Alternative 2A are within the range of flows that are simulated under Alternative 1. Flow changes under Alternative 2A would have minimal effect on movement and survival of juvenile green sturgeon. No mitigation is required.

Impact Fish-78: Operations-Related Increases in SWP Pumping and Resulting Entrainment Losses of Green Sturgeon. SWP and CVP pumping for Alternative 2A varies from pumping that was simulated for Alternative 1 (Figure 6.1-9). Change in pumping potentially alters entrainment and losses of juvenile green sturgeon from the Sacramento River basin and the South Delta. However, increases in pumping under Alternative 2A would have a minimal effect on green sturgeon entrainment. This determination is based on the fact that:

- In the past 12 years, only 99 juvenile green sturgeon have been entrained in the pumping facilities (IEP 2005), indicating that they rarely use the South Delta as rearing habitat and/or they are not subject to entrainment, relative to other species; and
- Implementation of Mitigation Measure Fish-MM-1 would reduce the potential for entrainment of green sturgeon.

This impact is less than significant. No mitigation is required.

Impact Fish-79: Operations-Related Reduction in Food Availability for Green Sturgeon. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for juvenile green sturgeon. Changes in water supply operations potentially affect prey habitat in the Sacramento and Feather Rivers. The flow simulated for 1922–1994 in the Sacramento and Feather Rivers for Alternative 2A varies relative to flow under Alternative 1 (Figure 6.1-5). The reduction in flow in some months and increases for other months and years has minimal effect on the range of flows that could affect rearing habitat area for juvenile green sturgeon (Table 6.1-14) and would likely have minimal effect on habitat supporting prey organisms. The impact on food for green sturgeon would be less than significant. No mitigation is required.

2020 Conditions

SWP and CVP pumping under 2020 conditions would be similar to operational conditions simulated under 2001 conditions (see Alternative 2A under 2001 conditions).

Changes in flow and diversions may affect fish and fish habitat in reaches of the Trinity, Sacramento, Feather, American, and San Joaquin Rivers and in the Delta and Suisun Bay. The simulated flow volume for the San Joaquin River and its tributaries for Alternative 2A under 2020 conditions is similar to the simulated flow for Alternative 1 under 2020 conditions (Figure 6.1-33). Similarly, flow in the Trinity River under Alternative 2A is nearly the same as flow under Alternative 1, with decreased flow in a few months (Figure 6.1-33). Flows for Alternative 2A under 2020 conditions for the Sacramento, Feather, and American Rivers frequently vary from flows for Alternative 1 under 2020 conditions (Figure 6.1-34). A consistent pattern of higher or lower flows, however, is not apparent. Specific effects on spawning and rearing habitat for Chinook salmon, steelhead, splittail, and green sturgeon are discussed in the following sections. These results are similar to those identified under 2001 conditions (see Alternative 2A under 2001 conditions, above).

Changes in Delta inflow from the Sacramento River reflect the cumulative effects of flow changes upstream on the Sacramento, Feather, and American Rivers (Figure 6.1-35). Changes in Sacramento River inflow between Alternative 2A and Alternative 1 under 2020 conditions potentially affect the proportion of flow drawn into the DCC and Georgiana Slough, although the effects appear to be relatively small (Figure 6.1-36). Changes in Delta outflow are similarly small relative to the outflow volume under Alternative 1, although slightly lower outflow results in some months (Figure 6.1-35). These results are similar to those identified under 2001 conditions (see Alternative 2A under 2001 conditions, above).

Delta outflow affects the downstream extent of fresh water and the estuarine salinity distribution. The parameter X2 (the distance in kilometers of the 2-ppt isohaline from the Golden Gate Bridge) is an indicator of potential effects of Delta outflow changes on salinity distribution. The simulated tidal hydraulic impacts for Alternative 2A under 2020 conditions would be similar to those simulated for Alternative 2A under 2001 baseline conditions because the simulated pumping patterns are similar (See Figure 5.2-28). Comparison of X2 for Alternative 1 and Alternative 2A under 2020 conditions indicates that for most months salinity distribution is similar (Figure 6.1-37). However, an upstream shift is relatively frequent during October and November. These results are similar to those identified under 2001 conditions (see Alternative 2A under 2001 conditions, above).

SWP and CVP combined pumping for Alternative 2A varies slightly from pumping that was simulated for Alternative 1 under 2020 conditions (Figure 6.1-38), but the pattern of pumping is similar to the pattern under 2001 conditions (see Figure 6.1-9 under Alternative 2A 2001 conditions, above). On average, CVP pumping is similar under 2020 conditions for Alternatives 1 and 2A, but

SWP pumping, averaged over the 73-year simulation, increases for every month. Although changes in exports are generally small, SWP pumping increases by at least 10% every month during at least 10% of the simulated years (1922–1994). Water supply changes associated with the Alternative 2A monthly changes simulated under 2020 conditions are similar to the impacts identified for 2001 conditions. Table 5.1-4 shows the simulated 2020 CVP pumping patterns compared to the 2001 CVP pumping patterns for Alternative 2A. Table 5.1-6 shows the simulated 2020 SWP pumping patterns compared to the 2001 SWP pumping patterns for Alternative 2A.

Therefore, because the simulated results of this alternative under 2020 conditions are similar to the results under 2001 conditions, operations-related impacts for Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon would be similar to the operational impacts described for Alternative 2A under 2001 conditions (i.e., Impact Fish-42 through Impact Fish-76).

Interim Operations

Implementation of Interim Operations would result in impacts less than those described above for Alternative 2A. Interim Operations would be similar to the proposed operations for December 15 through March 15 for Alternative 2A. The only interim operational changes are in the December 15–March 15 period, when the 8,500 cfs SWP pumping limit is assumed. There are no substantial changes in CVP pumping during these months, but SWP pumping would increase by more than 1,000 cfs during these months in only about 20% of the years (see Section 5.1, Water Supply). However, one of the conditions for Interim operations is that no substantial fish effects are allowed; therefore, effects under Interim Operations would be less than those described under Alternative 2A for December–March, and the same as Alternative 1 for the remainder of the year (i.e., no impacts).

Alternative 2B

Stage 1 (Physical/Structural Component)

Activities to construct and operate the gates are the same as under Alternative 2A. Therefore, construction-related impacts for Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green surgeon are identical to the physical/structural impacts described under Alternative 2A (i.e., Impact Fish-1 through Impact Fish-41). The impacts of gate operations on fish are the same as described under Alternative 2A.

2020 Conditions

The impacts from construction and operation of the physical components of this alternative under 2020 conditions would be the same as those under 2001 conditions—construction activities for Alternative 2B would include all activities described for Alternative 2A. Therefore, construction-related impacts for Chinook salmon, steelhead, delta smelt, splittail, striped bass, green sturgeon are identical to the physical/structural impacts described for Alternative 2A under 2001 conditions (i.e., Impact Fish-1 through Impact Fish-41).

Stage 2 (Operational Component)

Relative to Alternative 1, water supply operations with implementation of the SDIP under Alternative 2B would have minimal effect on total Delta pumping and shift the timing of pumping in some months (Appendix K, “Tables and Figures Supporting the Impact Assessment of the SDIP on Fish, Alternatives 1, 2A–2C, 3B, 4B”). Changes in flow in the Trinity, Sacramento, Feather, American, and San Joaquin Rivers are similar to flow changes described under Alternative 2A (Figure 6.1-5; Appendix K). Changes in reservoir storage are negligible, as under Alternative 2A. Changes in Delta inflow from the Sacramento River, effects on flow drawn into the DCC and Georgiana Slough, and changes in Delta outflow (i.e., as reflected by X2) are also similar to changes described under Alternative 2A.

Chinook Salmon

Operations-related impacts of implementing Alternative 2B on winter-, spring-, and fall-/late fall–run Chinook salmon in Central Valley rivers and the Delta are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-42), rearing habitat area (Impact Fish-43), migration habitat conditions (Impact Fish-44), water temperature (Impact Fish-45), and food (Impact Fish-48) reflect the less-than-significant impacts that would also occur under Alternative 2B. Figures and tables for Alternative 2B impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses (Impact-Fish-46 and Impact-Fish-47) are less than the impacts described under Alternative 2A and are less than significant for Alternative 2B as described below.

Under Alternative 1, simulated SWP and CVP pumping result in estimated annual losses of fall-run Chinook salmon that range from about 10,000 juveniles to 55,000 juveniles (Figure 6.1-28). Most fall-run Chinook salmon entrainment losses have occurred historically during May (Appendix J). Entrainment losses under Alternative 2B vary little from Alternative 1, with some substantial reductions in a few years (Figure 6.1-28). Given the relatively small change in entrainment losses in most years, the impact on fall-run Chinook salmon originating from the Sacramento and San Joaquin Rivers is considered less than significant.

Simulated SWP and CVP pumping result in estimated annual losses of late fall–run Chinook salmon that range from about 400 juveniles to 1,500 juveniles (Figure 6.1-28). Entrainment losses for late fall–run Chinook salmon are generally reduced under Alternative 2B, providing a potential small benefit.

Simulated SWP and CVP pumping result in estimated annual losses of winter-run Chinook salmon under Alternative 1 that range from about 1,000 juveniles to 5,000 juveniles (Figure 6.1-28). Similar to late-fall run, entrainment losses are generally reduced under Alternative 2B and may provide a small benefit.

Simulated SWP and CVP pumping result in estimated annual losses of spring-run Chinook salmon under Alternative 1 that range from about 5,000 juveniles to 35,000 juveniles (Figure 6.1-28). Entrainment losses under Alternative 2B vary little from Alternative 1, with some substantial reductions in a few years (Figure 6.1-28). Given the relatively small change in entrainment losses in most years, the impact on spring-run Chinook salmon is considered less than significant. No mitigation is required.

Coho Salmon

Operations-related impacts of implementing Alternative 2B on coho salmon in the Trinity River are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-49), rearing habitat area (Impact Fish-50), migration habitat conditions (Impact Fish-51), water temperature (Impact Fish-52), and food (Impact Fish-53) reflect the effects and less-than-significant impacts that would also occur under Alternative 2B. Figures and tables for Alternative 2B impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Steelhead

Operations-related impacts of implementing Alternative 2B on steelhead in Central Valley rivers and the Delta are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-54), rearing habitat area (Impact Fish-55), migration habitat conditions (Impact Fish-56), water temperature (Impact Fish-57), and food (Impact Fish-59) reflect the less-than-significant impacts that would also occur under Alternative 2B. Figures and tables for Alternative 2B impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses (Impact Fish-58) are less than the impacts described under Alternative 2A and are less than significant under Alternative 2B as described below.

Under Alternative 1, simulated annual salvage of steelhead varies from about 1,000 juveniles to 4,500 juveniles (Figure 6.1-29). Salvage, and hence entrainment losses, generally decreases under Alternative 2B, approaching or exceeding a 10% decrease in some years. Reduced entrainment losses would have a small beneficial effect.

Delta Smelt

Operations-related impacts of implementing Alternative 2B on delta smelt are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-60), rearing habitat area (Impact Fish-61), and migration habitat conditions (Impact Fish-62), reflect the less-than-significant impacts that would also occur under Alternative 2B. Figures and tables for Alternative 2B impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses and food availability (Impact Fish-63 and Impact Fish-64) are less than the impacts described under Alternative 2A and are less than significant as described below.

Under Alternative 1, simulated annual salvage of delta smelt varies from about 6,000 to 35,000 individuals (Figure 6.1-30). Most delta smelt (i.e., about 90%) are salvaged during May–July. Salvage increases slightly under Alternative 2B. The increases are generally less than 5%, and substantial decreases (i.e., 10% to 30%) occur in a few years (Figure 6.1-30). Given the small increase in salvage and the larger reductions in some years, the impact on delta smelt is considered less than significant. No mitigation is required.

Splittail

Operations-related impacts of implementing Alternative 2B on splittail in Central Valley rivers and the Delta are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-65), rearing habitat area (Impact Fish-66), migration habitat conditions (Impact Fish-67), and food (Impact Fish-69) reflect the less-than-significant impacts that would also occur under Alternative 2B. Figures and tables for Alternative 2B impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K. Impacts associated with entrainment losses are less than the impacts described under Alternative 2A (Figure 6.1-31) and are less than significant.

Striped Bass

Operations-related impacts of implementing Alternative 2B on striped bass are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-70), rearing habitat area (Impact Fish-71), and migration habitat conditions (Impact Fish-72), reflect the less-than-significant impacts that would also occur under Alternative 2B. Figures and tables for Alternative 2B impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses and food availability (Impact Fish-73 and Fish-74) are less than the impacts described under Alternative 2A and are less than significant.

Green Sturgeon

Operations-related impacts of implementing Alternative 2B on green sutrgeon are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-75), rearing habitat area (Impact Fish-76), migration habitat conditions (Impact Fish-77), and food availability (Impact Fish-79) reflect the less-than-significant impacts that would also occur under Alternative 2B. Impacts associated with entrainment losses are similar to the impacts described under Alternative 2A (Impact Fish-78).

2020 Conditions

Because the simulated operations of this alternative under 2020 conditions are similar to the results under 2001 conditions, operations-related impacts for Chinook salmon, steelhead, delta smelt, splittail, striped bass, green sturgeon would be similar to the operational impacts described for Alternative 2B under 2001 conditions.

Alternative 2C

Stage 1 (Physical/Structural Component)

Activities to construct and operate the gates are the same as under Alternative 2A. Therefore, construction-related impacts for Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon are identical to the construction-related impacts described under Alternative 2A (Impact Fish-1 through Impact Fish-41).

2020 Conditions

The physical/structural component of this alternative is the same as Alternative 2A, and the impacts from construction of the physical/strucutural component of this alternative under 2020 conditions would be the same as those under 2001 conditions. Therefore, construction-related impacts for Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon are identical to the physical/structural impacts described for Alternative 2A under 2001 conditions (i.e., Impact Fish-1 through Impact Fish-41).

Stage 2 (Operational Component)

Relative to Alternative 1, water supply operations with implementation of the SDIP under Alternative 2C would have a small effect on total Delta pumping and shift the timing of pumping in some months (Appendix K). Changes in flow in the Trinity, Sacramento, Feather, American, and San Joaquin Rivers are similar to flow changes described under Alternative 2A (Figure 6.1-5; Appendix K). Changes in reservoir storage are negligible, as under Alternative 2A. Changes in Delta inflow from the Sacramento River, effects on flow drawn into the DCC and Georgiana Slough, and changes in Delta outflow (i.e., as reflected by X2) are similar to changes described under Alternative 2A (Figure 6.1-6, Figure 6.1-7, Figure 6.1-8).

Chinook Salmon

Operations-related impacts of implementing Alternative 2C on winter-, spring-, and fall-/late fall–run Chinook salmon in Central Valley rivers and the Delta are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-42), rearing habitat area (Impact Fish-43), migration habitat conditions (Impact Fish-44), water temperature (Impact Fish-45), and food availability (Impact Fish-48), reflect the less-than-significant impacts that would also occur under Alternative 2C. Figures and tables for Alternative 2C impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses and food availability (Impact Fish-46 and Fish-47) are similar to the impacts described under Alternative 2A. The same mitigation measures (Fish-MM-1 and Fish-MM-2) would result in less-than-significant impacts on Chinook salmon.

Coho Salmon

Operations-related impacts of implementing Alternative 2C on coho salmon in the Trinity River are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-49), rearing habitat area (Impact Fish-50), migration habitat conditions (Impact Fish-51), water temperature (Impact Fish-52), and food (Impact Fish-53) reflect the effects and less-than-significant impacts that would also occur under Alternative 2C. Figures and tables for Alternative 2C impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Steelhead

Operations-related impacts of implementing Alternative 2C on steelhead in Central Valley rivers and the Delta are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-54), rearing habitat area (Impact Fish-55), migration habitat conditions (Impact Fish-56), water temperature (Impact Fish-57), and food availability (Impact Fish-59) reflect the less-than-significant impacts that would also occur under Alternative 2C. Figures and tables for Alternative 2C impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses (Impact Fish-58) are similar to the impacts described under Alternative 2A. Fish-MM-1 and Fish-MM-2 would result in a less-than-significant impact on steelhead.

Delta Smelt

Operations-related impacts of implementing Alternative 2C on delta smelt are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-60), rearing habitat area (Impact Fish-61), and migration habitat conditions (Impact Fish-62), reflect the less-than-significant impacts that would also occur under Alternative 2C. Figures and tables for Alternative 2C impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses and food availability (Impact Fish-63 and Fish-64) are similar to the impacts described under Alternative 2A. Fish-MM-1, Fish-MM-2, and Fish-MM-3 would result in a less-than-significant impact on delta smelt.

Splittail

Operations-related impacts of implementing Alternative 2C on splittail in Central Valley rivers and the Delta are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-65), rearing habitat area (Impact Fish-66), migration habitat conditions (Impact Fish-67), and food availability (Impact Fish-69) reflect the less-than-significant impacts that would also occur under Alternative 2C. Figures and tables for Alternative 2C impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses (Impact Fish-68) are less than significant and similar to the impacts described under Alternative 2A.

Striped Bass

Operations-related impacts and subsequent mitigation measures of implementing Alternative 2C on striped bass are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-70), rearing habitat area (Impact Fish-71), and migration habitat conditions (Impact Fish-72), reflect the less-than-significant impacts that would also occur under Alternative 2C. Figures and tables for Alternative 2C impacts that correspond to the figures and tables cited under the Alternative 2A discussion are found in Appendix K.

Impacts associated with entrainment losses and food availability (Impact Fish-73 and Fish-74) are similar to the impacts described under Alternative 2A. Mitigation Measures Fish-MM-1, Fish-MM-2, and Fish-MM-3 would result in a less-than-significant impact on striped bass.

Green Sturgeon

Operations-related impacts of implementing Alternative 2C on green sturgeon are similar to those described under Alternative 2A. Impacts described under Alternative 2A for spawning habitat area (Impact Fish-75), rearing habitat area (Impact Fish-76), migration habitat conditions (Impact Fish-77), and food availability (Impact Fish-79) reflect the less-than-significant impacts that would also occur under Alternative 2C. Impacts associated with entrainment losses are similar to the impacts described under Alternative 2A (Impact Fish-78).

2020 Conditions

Because the simulated results of this alternative under 2020 conditions are similar to the results under 2001 conditions, operations-related impacts for Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon would be similar to the operational impacts described for Alternative 2C under 2001 conditions.

Alternative 3B

Stage 1 (Physical/Structural Component)

Construction activities under Alternative 3B include all activities described under Alternative 2A, with the exception of the Grant Line Canal Gate, which would not be built or operated. Therefore, construction-related impacts on Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon are similar to, but slightly less than, the construction-related impacts described under Alternative 2A (Impact Fish-1 through Impact Fish-41). Operation of the gates under Alternative 3B would be the same as described under Alternative 2B, with the exception of not building/operating the Grant Line Canal Gate. Therefore the impacts of gate operations on fish are nearly the same, but less than as described under Alternative 2B (Impacts Fish-42 through Impact Fish-79).

2020 Conditions

The impacts from construction of the physical/structural component of this alternative would be similar to, but slightly less than, the construction-related impacts described for Alternative 2A, resulting in similar but slightly less impacts on Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon (see Alternative 2A under 2001 conditions, Impact Fish-1 through Impact Fish-41).

Stage 2 (Operational Component)

The monthly SWP and CVP operational patterns of Alternative 3B are the same as those of Alternative 2B (see Alternative 2B in Sections 5.1, Water Supply, and 5.3, Water Quality). Therefore, the operational impacts resulting from state and federal operations under Alternative 3B are the same as described for Alternative 2B.

Thus, operations-related impacts for Alternative 3B on Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon are the same for operational patterns described for Alternative 2B under 2001 conditions.

2020 Conditions

Water supply for Alternative 3B under 2020 conditions are similar to water supply for 2001 conditions. Streamflows, pumping, and diversions associated with Alternative 3B simulated under 2020 conditions are similar to the 2001 conditions simulation. Therefore, the impacts for the operational component for Alternative 3B under 2020 conditions and their levels of significance on Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon are the same as the impacts described for 2001 conditions, and subsequently, are nearly the same as for Alternative 2B under 2001 conditions.

Alternative 4B

Stage 1 (Physical/Structural Component)

Construction activities under Alternative 4B include all activities described under Alternative 2A, with the exception of the flow control gates (i.e., Grant Line Canal, Old River, and Middle River gates). Under Alternative 4B, the fish control gate at the head of Old River would be constructed and operated. Therefore, physical/structural component impacts on Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon are similar to, but less than, the physical/structural component impacts described under Alternative 2A (Impact Fish-1 through Impact Fish-41). Operation of the head of Old River fish control gate under Alternative 4B would be the same as described under Alternative 2B, with the exception of not building/operating the 3 flow control gates. Therefore the impacts of gate operations on fish are the nearly the same, but less than as described under Alternative 2B or 3B (Impacts Fish-42 through Impact Fish-79).

2020 Conditions

The physical/structural component of this alternative is the same as Alternative 2A, with the exception of the flow control gates (i.e., Grant Line Canal, Old River, and Middle River gates), and the impacts from construction and operation of the physical/structural component of Alternative 4B under 2020 conditions would be the same as those described under 2001 conditions. Hence, the impacts from construction and operation of the physical/structural component of this alternative would be similar to, but slightly less than, the construction-related impacts described for Alternative 2A, resulting in similar but slightly less impact on Chinook salmon, steelhead, delta smelt, splittail, striped bass, and green sturgeon (see Alternative 2A under 2001 conditions, Impact Fish-1 through Impact Fish-41).

Stage 2 (Operational Component)

The monthly state and federal operational patterns of Alternative 4B are the same as Alternative 2B (see Alternative 2B in Sections 5.1, Water Supply, and 5.3, Water Quality). Therefore, the operational impacts resulting from state and federal operations under Alternative 4B are the same as described for Alternative 2B.

Thus, operations-related impacts for Alternative 4B on Chinook salmon, steelhead, delta smelt, splittail, striped bass and green sturgeon are the same for operational impacts described for Alternative 2B under 2001 conditions.

2020 Conditions

Water supply for Alternative 4B under 2020 conditions are similar to water supply for 2001 conditions. Streamflows, pumping, and diversions associated with Alternative 4B simulated under 2020 conditions are similar to the 2001 conditions simulation. Therefore, the operations-related impacts for Alternative 4B under 2020 conditions and their levels of significance on Chinook salmon, steelhead, delta smelt, splittail, striped bass and green sturgeon are the same as the impacts described for 2001 conditions, and subsequently, are nearly the same as Alternative 2B under 2001 conditions.

Adaptive Management

To address uncertainties associated with the effectiveness of some of the mitigation measures described for SDIP alternatives, DWR and Reclamation will implement these measures based on the principles of adaptive management, which allow these measures to be adjusted over time, based on results of monitoring and research. The mitigation measures that are subject to adaptive management are related to measures designed to minimize effects on special-status fish species. These species and mitigation measures are shown below:

- Delta smelt—
  - Minimize Entrainment Losses of Juvenile Delta Smelt Associated with Increased SWP Pumping during March–June.
- Central Valley fall-/late fall–run Chinook salmon, Central Valley spring-run Chinook salmon, Sacramento winter-run Chinook salmon, and Central Valley steelhead—
  - Minimize Entrainment-Related Losses of Juvenile Fall-/Late Fall–Run Chinook Salmon Associated with Increased SWP Pumping during March–June.

Results of SDIP effectiveness monitoring and relevant monitoring and research conducted through the CALFED Science Program will be used to determine the effectiveness of these mitigation measures in minimizing effects on special-status fish species. Based on this assessment of monitoring and research results, the measures may be modified to improve their effectiveness. Modifications to the mitigation measures may be proposed by DWR, Reclamation, USFWS, NOAA Fisheries, or DFG. The process for adaptively managing implementation of these measures is described below:

1. **Assessment of Effectiveness of Mitigation Measures.** An annual monitoring report will be prepared that will include an analysis of monitoring results to determine the effectiveness of mitigation measures. Monitoring reports will be submitted to CBDA and the resource agencies for review.
2. **Recommendations for Modifying Mitigation Measures.** Based on the analysis of SDIP monitoring results, DWR and Reclamation may propose modifications to the mitigation measures to improve their effectiveness. The resource agencies will be notified in writing of the proposed modifications and will review the proposed modifications, including the supporting data analyses. If the resource agencies concur with the proposed modifications, they will be implemented.

The resource agencies may also recommend modifications to the mitigation measures. The resource agencies will submit proposed modifications to DWR and Reclamation for review. If DWR and Reclamation concur with the proposed modifications, they will be implemented.

3. **Revisions to the Monitoring Program.** If mitigation measures are modified, the SDIP monitoring program will be revised to provide for monitoring and research to test the effectiveness of the modified measures.

Effects of South Delta Improvements Program on Environmental Water Account Fish Entrainment Protection Effectiveness

The average amount of EWA sponsored pumping reductions that are included in the 2001 CALSIM baseline simulation was 202 taf/yr. The CALSIM model for the SDIP alternatives included a constant purchase of 185 taf/yr; therefore, the variable assets (i.e., half of the SWP gains from CVPIA (b)(2) releases) were 17 taf/yr. The CALSIM 2001 and 2020 baseline simulations are consistent with each other and represent a typical EWA protection pattern within the CALSIM monthly model.

SDIP alternatives may allow increased pumping during periods when EWA actions to reduce entrainment would be taken under the baseline. Additional EWA assets, therefore, would be required to provide the same level of fish protection and water deliveries. This additional SWP pumping would be either for Table A (firm) deliveries or for Article 21 (interruptible) deliveries. However, effects on fish entrainment depend only on the amount of pumping, and not on the type of deliveries being made. Most of the EWA actions to reduce SWP Banks pumping in April and May during VAMP would have the same water supply cost as the baseline because the baseline pumping is less than 6,680 cfs during this period. EWA actions during periods when allowable SDIP pumping is increased would require more EWA assets to maintain the same entrainment protection.

Appendix B, “Simulation of EWA Actions to Reduce Fish Entrainment Losses,” describes the likely effects of 8,500-cfs pumping limit on EWA and fish protection for several recent years. An interagency EWA exercise using an interactive daily simulation model has been conducted, and the observed shifts in EWA assets generally correspond to relatively small shifts in necessary assets. The daily gaming model allowed higher pumping with the 8,500 cfs in the weeks following the specified fish protection actions. The recent years of actual EWA actions have focused pumping reduction actions on the April, May, and June periods when the baseline pumping is below the 6,680-cfs pumping limit and will not be increased with the SDIP increased pumping limits.

The SDIP fish assessment assumes that an expanded EWA (i.e., larger than the CALFED ROD EWA) will be adopted as part of future CALFED programs, and that this will match the general description used for the 2004 OCAP documents.

The mitigation measures that are required to reduce fish impacts of the SDIP Alternatives 2A and 2C to less-than-significant levels each involve reductions from the 8,500-cfs limit to the existing limit when EWA actions are taken to reduce pumping impacts. An EWA credit (of 10% to 30%) would also be given for increased pumping achieved with the increased SDIP limit in the months of November–March. These mitigation measures are designed to provide the identical level of EWA protections with the increased SWP Banks pumping (i.e., CCF diversion) limit. All of these SDIP mitigation measures would be incorporated into the expanded long-term EWA program, once it is adopted.

Effects of Water Transfers on Fish Entrainment

The CALSIM modeling of the 2001 and 2020 baselines (existing conditions and future no action) indicates that in many years there will be unused pumping capacity during the July–September period that may be available for moving additional water transfers through the Delta. This is the major “window of opportunity” for water transfers because the allowable E/I ratio is 65%, there are high water demands for beneficial uses of additional water transfers, there are relatively few fish-related impacts along the river corridors and within the Delta channels, and there are fewer entrainment losses of fish at the export pumps during these summer months. Water transfer capacity is available under existing conditions, and additional water transfer capacity would be provided in some years with the SDIP alternatives.

The SDIP alternatives include the simulation of water transfers made for EWA as generally described in the CALFED ROD and represented in the 2002 benchmark version of CALSIM. The effects of these simulated EWA transfers through the Delta are included in the CALSIM monthly Delta flow values and the subsequent DSM2 modeling and fisheries impact analysis. The Delta impacts of these simulated EWA transfers and exports are therefore fully evaluated in the SDIP impact assessment methods. The water transfer capacity was estimated by assuming that a maximum of 3,300 cfs would be added to each monthly pumping flow unless the existing pumping limit of 7,180 cfs for baseline or 8,500 cfs for SDIP alternatives had been reached. A maximum of 600 taf could therefore be transferred with an increment of 300 cfs for the 3-month period, if pumping capacity was available. Section 5.1 (Table 5.1-14) indicates that the average water transfer capacity based on the 2001 CALSIM baseline was 250 taf.

Alternative 2A would allow an increase in water transfers from 250 taf/yr associated with current pumping limits to 343 taf/yr. The SDIP increase in SWP Banks pumping would allow potential water transfers to increase by an average of 93 taf/yr. The potential fish impacts associated with these additional water transfers of 93 taf/yr would be SDIP indirect impacts. The 250 taf/yr of water transfers that might occur under the baseline conditions are considered in the cumulative effects analysis since they could occur without the SDIP project. (See Chapter 10 for the analysis of Fish effects.)

Table J-7 (Appendix J) shows the monthly historical salvage data at the SWP Skinner fish facility and indicates that the majority of delta smelt salvage has occurred in the months of April, May, June, and July. The average annual SWP entrainment for 1980–2002 was 27,500 fish. The annual entrainment has ranged from about 500 (in 1998) to more than 100,000 (in 1999). The median monthly SWP salvage density values are highest in the months of May (1.64 fish/cfs), June (3.09 fish/cfs), and July (0.45 fish/cfs). June pumping causes the highest entrainment; May pumping causes about half as much entrainment, and July pumping causes 15% of the entrainment caused by June pumping. There is some entrainment in January and February, but this winter pumping entrains only 5% as many fish as May pumping. However, because these adult delta smelt are ready to spawn, they may be more important than the small numbers would indicate.

The possible indirect entrainment impacts of the water transfers in July–September were calculated using the monthly salvage density patterns, and were based on the maximum transfer capacity of 3,300 cfs (see Table 5.1-14). Because there are relatively low salvage densities for the protected fish species (delta smelt, steelhead, and Chinook salmon runs) during the transfer window, the increased entrainment from the transfers are relatively small. Only delta smelt has a large enough assumed salvage density in July to raise the delta smelt entrainment by more than a few percent of the annual entrainment. The delta smelt entrainment would increase by about 1,500 fish in July with a maximum water transfer of 3,300 cfs assuming the median delta smelt density. This would represent about 5% of the average annual entrainment of delta smelt for the 2001 baseline and is considered to be less than significant. If SWP Banks salvage data and the 20-mm delta smelt surveys indicate that the maximum possible July water transfers of 3,300 cfs would pose a substantial risk for the delta smelt population in a particular year (i.e., late spawning with a peak juvenile abundance in July), the normal EWA adaptive management decision-making procedures could be used to inform DWR to delay the beginning of the water transfers to mid-July, or to reduce the allowable water transfer in July.

Adaptive Management of Flow Control Gates for Fish Protection

Section 5.2, Delta Tidal Hydraulics, includes a discussion about how flow control gate operations will affect tidal level and tidal flow in the south Delta channels. This section describes the general influences of the gate operations on south Delta fish habitat and fish movement patterns and gives some general fish protection guidelines that will be incorporated into the adaptive management operations of the flow control gates. All of the SDIP project purposes, as well as the tidal hydraulic and water quality mitigation measures and fish protection measures, can be achieved with the consistent operations of the flow control gates, as described below.

Partially closing the head of Old River fish control gate can reduce the diversion of high-EC San Joaquin River water into the south Delta channels (WQ-MM-2) and provide some protection for any fish migrating downstream in the San Joaquin River (i.e., Chinook salmon, steelhead, and splittail). Maintaining a minimum head of Old River diversion of at least 10% of the Vernalis flow to increase flushing of south Delta channels (WQ-MM-3) will only slightly reduce the protection for juvenile Chinook salmon in April and May, and is consistent with the existing temporary barrier operations with culverts. The permanent flow control gate can be operated for a longer period (i.e., corresponding to early migration of juvenile Chinook salmon in wet years) than is possible with the temporary barrier (April 15–May 15), and thereby increase the duration of the protection of juvenile Chinook salmon.

Flow control gate operations (HY-MM-3) to provide more net tidal flows from Victoria Canal into Middle River and from Old River at Clifton Court Ferry into the Old River channel upstream of CVP Tracy will lower the EC of the western portion of these channels. However, the possible effects of these flow control gate operations on fish habitat and movement are unknown. Although these south Delta channels may provide suitable delta smelt and Chinook salmon rearing habitat, the risk of entrainment during periods of fish movement is relatively high. Flow control gate operations are not assumed to offer any advantage to fish habitat or movement, or to provide any protection from entrainment in the CVP and SWP pumping facilities.

Daily Operations of South Delta Flow Control Gates

The simulated effects of operations of the south Delta flow control gates on tidal level and tidal and net flows have been accurately described in Section 5.2. Based on these simulated tidal hydraulic effects and the anticipated water quality and fish protection effects, the major decisions (choices) for operating each flow control gate must be considered within an adaptive management framework to satisfy the several interrelated purposes of these gates. Adaptive management procedures for the south Delta flow control gates can be developed from three gate operation choices to provide maximum water level, water quality, and fish protection benefits from the flow control gate operations:

1. Operation of the CCF intake gates have two main effects that must be balanced: If the gates are closed during the flood-tide flows prior to the high tide each day, the tidal flushing in south Delta channels can be maximized, and levels at high tide throughout the south Delta channels are preserved. This will allow Tom Paine Slough siphons to operate and provide the maximum tidal flushing upstream of the flow control gates. Fish migration patterns for Chinook salmon or delta smelt might be triggered or cued to tidal fluctuations or diurnal periods (i.e., dawn and dusk). As more is learned about these diurnal or tidal migration patterns, the CCF gate schedule might be modified to reduce opening at peak fish density periods within the day. The CCF intake gates, however, must be opened for a sufficient period each day to maintain the CCF elevations above -2.0 feet msl to prevent cavitation

problems at SWP Banks, which is often used for maximum off-peak (nighttime) pumping.

2. The head of Old River fish control gate can be operated to reduce the San Joaquin River diversions into Old River. This will increase the San Joaquin River flow past Stockton and improve DO conditions in the DWSC, which is assumed to provide fish habitat benefits. Reduction of the head of Old River diversions will also reduce the inflow of higher-salinity San Joaquin River water into the south Delta channels. This may also be beneficial for adult up-migrating Chinook salmon past Stockton during the months of September through November. However, reduced diversions will cause more water to be drawn from the central Delta to supply the CVP and SWP pumping, which may increase entrainment of some larval or juvenile fish (e.g., delta smelt) from the central Delta. Partial closure of the head of Old River gate will also shift the distribution of San Joaquin River salinity away from the CVP Tracy facility toward the CCWD intakes and the SWP Banks facility. There do not appear to be any substantial effects on water levels in the south Delta channels from reduced San Joaquin River diversions at the head of Old River if flow control gates are being operated. Closure of the fish control gate for fish protection or DO improvement may be possible for more of the time than was simulated in the DSM2 modeling of the SDIP alternatives. The fish control gate operations must satisfy the SDIP objective to protect outmigrating Chinook salmon juvenile smolts, as well as satisfy HY-MM-2, WQ-MM-2, WQ-MM-3, and WQ-MM-4.

3. The flow control gates at Grant Line Canal, Old River at DMC, and Middle River can be used to control the water levels in the south Delta channels. In addition, ebb-tide closure of the Old River and Middle River flow control gates can produce a net circulation upstream on Old River and Middle River and downstream in Grant Line Canal. This ebb-tide closure of Old and Middle River flow control gates is expected to have a beneficial effect on salinity in these south Delta channels and should be considered for Alternatives 2A, 2B, and 2C, although only required as mitigation for Alternative 3B. The ebb-tide closure of the flow control gates is not anticipated to substantially change the fish movement patterns that are triggered by or associated with tidal flows.

Mitigation Measures HY-MM-1, HY-MM-2, and HY-MM-3, as well as WQ-MM-1, WQ-MM-2, WQ-MM-3, and WQ-MM-4, involve operations of the CCF gates, the head of Old River fish control gate, and the Old River and Middle River flow control gates to provide more suitable tidal hydraulic and water quality conditions in the south Delta channels, and provide protection for migrating fish in the San Joaquin River. These mitigation measures will vary on a day-by-day basis depending on the inflows, export pumping, and water quality conditions measured at Vernalis and within the south Delta, as well as fish densities measured at the CVP and SWP salvage facilities and in the Mossdale trawls. Each of these mitigation measures therefore should be implemented using these recommended adaptive management procedures for operating the south Delta flow control gates.

6.2 Vegetation and Wetlands

Introduction

This section presents the results and the evaluation of the impacts on constructing or operating the SDIP on vegetation and wetlands. This section:

- provides a description of land cover types, special-status plant species, and waters of the United States;
- evaluates and discusses the impacts associated with construction and operation in the project area; and
- recommends measures to mitigate significant impacts in the project area.

Summary of Significant Impacts

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

Table 6.2-S. Summary of Significant Impacts on and Mitigation for Vegetation and Wetlands

Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
VEG-1: Loss or Alteration of Nonjurisdictional Woody Riparian Communities as a Result of Gate Construction, Gate Operation, and Channel Dredging	2A–2C, 3B, 4B	Significant	VEG-MM-1: Minimize Impacts on Sensitive Biological Resources VEG-MM-2: Compensate for Unavoidable Temporary and Permanent Loss of Riparian Habitats	Less than significant
VEG-4: Spread of Noxious Weeds as a Result of Gate Construction and Channel Dredging	2A–2C, 3B, 4B	Significant	VEG-MM-3: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging	Less than significant
VEG-5: Loss or Disturbance of Mason's Lilaeopsis Stands or Potential Habitat as a Result of Gate Construction, Gate Operation, and Channel Dredging	2A–2C, 3B, 4B	Significant	VEG-MM-1: Minimize Impacts on Sensitive Biological Resources VEG-MM-4: Conduct Preconstruction Surveys for Special-Status Plants VEG-MM-5: Minimize Impacts on and Compensate for Loss of Mason's Lilaeopsis VEG-MM-6: Monitor Existing Stands of Mason's Lilaeopsis during Gate Operations	Less than significant

Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
VEG-6: Loss or Disturbance of Delta Mudwort Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging	2A–2C, 3B, 4B	Significant	VEG-MM-1: Minimize Impacts on Sensitive Biological Resources VEG-MM-4: Conduct Preconstruction Surveys for Special-Status Plants VEG-MM-5: Minimize Impacts on and Compensate for Loss of Mason's Lilaeopsis VEG-MM-6: Monitor Existing Stands of Mason's Lilaeopsis during Gate Operations	Less than significant
VEG-7: Loss of Rose-Mallow Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging	2A–2C, 3B, 4B	Significant	VEG-MM-1: Minimize Impacts on Sensitive Biological Resources VEG-MM-4: Conduct Preconstruction Surveys for Special-Status Plants VEG-MM-7: Avoid and Minimize Impacts on Special-Status Plants VEG-MM-8: Compensate for Unavoidable Impacts on Tule and Cattail Tidal Emergent Wetlands	Less than significant
VEG-8: Filling of Tule and Cattail Tidal Emergent Wetland and Jurisdictional Riparian Communities as a Result of Gate Construction, Gate Operation, and Channel Dredging	2A–2C, 3B	Significant	VEG-MM-1: Minimize Impacts on Sensitive Biological Resources VEG-MM-2: Compensate for Unavoidable Temporary and Permanent Loss of Riparian Habitats VEG-MM-7: Avoid and Minimize Impacts on Special-Status Plants. VEG-MM-9: Monitor Existing Stands of Tidal Emergent Wetland and Riparian Wetland Vegetation during Gate Operation	Less than significant
VEG-9: Filling or Disturbance of Tidal Perennial Aquatic Habitat as a Result of Gate Construction, Gate Operation, and Channel Dredging	2A–2C, 3B, 4B	Significant	VEG-MM-1: Minimize Impacts on Sensitive Biological Resources VEG-MM-10: Compensate for Loss of Tidal Perennial Aquatic Habitat	Less than significant

Affected Environment

The study area as defined for this chapter includes all waterways identified by the DWR Delta Modeling Branch as being affected by gate operation (Figure 6.2-1).

The project area is defined as the construction and dredging zone for the four gate sites (Figures 6.2-2–6.2-5), the three proposed dredge areas and the associated dredged material disposal sites (Figures 6.2-6–6.2-8), and the siphon extension sites (Figure 2-8).

Sources of Information

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

- studies conducted specifically for the project,
- published literature, and
- previous studies conducted for CALFED.

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 (e.g., agricultural lands, landscaping). For the purpose of this EIS/EIR, most land cover types were mapped in the portion of the study area between the levees, although the agriculture land cover type was partially included at the gate sites (Figures 6.2-1–6.2-8 and Table 6.2-1). The regulatory compliance documents for the SDIP will be consistent with the programmatic documents prepared for CALFED. For this reason, the land cover types identified in the study area for this project are defined based on the CALFED Multi-Species Conservation Strategy (MSCS), which serves as a Natural Community Conservation Plan (NCCP) for compliance of CALFED with the Natural Community Conservation Plan Act (CALFED Bay-Delta Program 2000e).

DWR conducted surveys and mapped the land cover types in the study area in 2000 and 2001. Riparian areas and levee faces were surveyed from a slowly moving boat. Botanical surveys of uplands adjacent to existing and proposed gate sites were conducted by foot in an area extending 500 feet inland from the levee and 500 feet upstream and downstream from proposed gate sites.

DWR botanists mapped and characterized representative sites for the major land cover types within the SDIP area of impact. Large representative stands of the dominant vegetation types were selected at sites throughout the project area. The vegetation was described (species composition and cover), and the location was recorded with a Global Positioning System (GPS) unit. These representative sites were superimposed onto orthorectified, georeferenced aerial photographs of the area (September 1, 2000, 1:2400 scale, acquired at low tide). The aerial photographs were used to classify and map riparian/streamside vegetation. Acreages were calculated either from the GIS data or were planimetered from the aerial photographs.

Jones & Stokes botanists conducted a reconnaissance-level survey of the proposed gate sites on April 16, 2002 and botanical surveys of the proposed dredged material disposal sites on Roberts Island and Stewarts Tract on November 23, 2004.

Additional information on land cover types was reviewed in existing documents previously prepared for the project (California Department of Water Resources and Bureau of Reclamation 1996a) and for CALFED (2000b and 2000e). This information is based on reconnaissance-level surveys conducted within and outside of the study area.

Special-Status Plants

A consolidated list of special-status plant species that potentially occur and were included in the 2000–2001 plant surveys in the study area was generated from four sources:

- USFWS Species List provided for the SDIP, dated November 8, 2004 (Appendix M; U.S. Fish and Wildlife Service 2004);
- CNDDB (California Natural Diversity Database 2001);
- CNDDB (California Natural Diversity Database 2004); and
- California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California (California Native Plant Society 2001).

Each species on the list 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 6.2-2.

DWR conducted special-status plant surveys of the study area in 2000 and 2001 to map all occurrences of special-status species in waterways, around all in-channel islands, and in uplands adjacent to existing barriers and proposed gate sites in the SDIP area of impact (Figure 6.2-1). Surveys of waterways and in-channel islands were conducted from a slowly moving boat that allowed staff to reliably find all occurrences of special-status species. DWR botanists conducted floristic surveys of data point areas for vegetation and wetland surveys by examining the entire site by foot and searching for special-status species. Proposed dredged material disposal sites were not included in the study area surveys.

Special-status plant surveys were dispersed throughout the growing season to allow observation of different plant species during their respective flowering periods. Surveys were conducted from June to September to encompass the flowering period of all target special-status species (Table 6.2-2).

Attempts were made to relocate all plant occurrences listed on the CNDDB (California Natural Diversity Database 2001) for the SDIP area of impact. Attempts to relocate two species listed on the CNDDB (marsh skullcap and

Table 6.2-1. Existing Land Cover Types in the SDIP Study Area and Project Area

NCCP Community Type	Land Cover Type	Total Acres in Study Area	Acreage at Gate Sites: Middle River Flow Control Gate	Acreage at Gate Sites: Grant Line Canal Flow Control Gate	Acreage at Gate Sites: Old River at DMC Flow Control Gate	Acreage at Gate Sites: Head of Old River Fish Control Gate	Acreage at Dredging Areas: West Canal Conveyance Dredging Area	Acreage at Dredging Areas: Middle River Conveyance Dredging Area	Acreage at Dredging Areas: Old River Conveyance Dredging Area	Acreage at Dredging Areas: Spot Dredging Areas for Agricultural Diversion	Acreage at Dredge Material Disposal Sites
Tidal perennial aquatic	Tidal perennial aquatic	2225.6	8.3	10.4	3.7	7.6	73.0	72.7	123.5	477.3	0
Tidal freshwater emergent	Tule and cattail tidal emergent wetland	121.2	0.5	0.4	0.4	0	3.3	6.6	8.7	29.04	0
Valley/foothill riparian	Cottonwood-willow woodland (upland and wetland)	384.5	0.4	1.9	0	0	14.2	28.3	69.0	89.7	3.8
	Valley oak riparian woodland	82.6	0	0	0	0	0.1	14.7	23.5	34.5	0.8
	Riparian scrub (upland and wetland)	131.9	0.7	1.0	0.9	0	5.0	28.2	24.2	23.7	2.4
	Willow scrub (upland and wetland)	133.6	0	0.1	0.2	0	4.3	14.4	25.5	22.0	6.6
	Giant reed stand	12.7	0	0	0	0	0.4	0.1	3.7	3.7	0
Upland cropland	Agriculture	125.5	0.5 [1]	2.5 [1]	13.5 [1]	1.6 [1]	0	0	0	0	101.5
Not applicable	Developed land	6.8	– [1]	– [1]	– [1]	– [1]	0	0	0.5	3.5	0
Not applicable	Landscaping	2.4	0	0	0	0	0	0	0.1	1.9	0
Not applicable	Ruderal	526.1	0.2	1.0	0	3.2	29.5	122.7	78.29	77.6	47.4
	Total	**3572.9**	**10.6**	**17.3**	**18.7**	**12.4**	**129.8**	**287.7**	**356.9**	**757.2**	**162.6**

Notes:

DMC = Delta-Mendota Canal.

[1] Agriculture acreages were planimetered from aerial photographs of the proposed dredge drying areas at the gate sites. Part of the agricultural land acreage included in the gate site dredge drying areas is ruderal vegetation, which has not yet been separately mapped in these areas. Developed land was not mapped at the gate sites.

Table 6.2-2. Special-Status Species with Potential to Occur in the Project Area

Species Name	Status [a]			Distribution	Preferred Habitats	Period Identifiable	Occurrence in the Project Area
	Federal	State	Other				
Suisun Marsh aster *Aster lentus*	SC	–	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	August–November	Populations recorded along Old River, approximately 5 miles north of proposed dredging section (CNDDB 2003). Not observed during project surveys.
Big tarplant *Blepharizonia plumosa* ssp. *plumosa*	SC	–	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	Degraded habitat in the project area. CNDDB occurrence approximately 3 miles south of project area (CNDDB 2003). Not observed during project area surveys.
Congdon's tarplant *Centromadia [Hemizonia] parryi* ssp. *congdonii*	SC	–	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	Suitable habitat in the project area. No CNDDB records within 5 miles of the project area. Not observed during project area surveys.
Slough thistle *Cirsium crassicaule*	SC	–	1B, CSC	San Joaquin Valley and San Joaquin, Kings, and Kern Counties	Marsh along sloughs and canals, riparian scrub, and chenopod scrub: 10-300 feet	May–August	Historical occurrence recorded at the confluence of Old River and San Joaquin River. Last seen in 1933 (CNDDB 2003). Not observed during project area surveys.
Delta coyote thistle *Eryngium racemosum*	–	CE	1B, CSC	San Joaquin River delta, floodplains, and adjacent Sierra Nevada foothills and Calaveras, Merced, San Joaquin*, and Stanislaus Counties	Riparian scrub, and seasonally inundated depressions along floodplains on clay soils: 10–250 feet	June–August	Suitable habitat in the project area. Extirpated CNDDB occurrence approximately 1 mile south of project area (CNDDB 2003). Not observed during project area surveys.

Species Name	Status [a]			Distribution	Preferred Habitats	Period Identifiable	Occurrence in the Project Area
	Federal	State	Other				
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	Present throughout south Delta. Populations observed during project surveys along West Canal dredging area, Grant Line Canal, Fabian and Bell Canal, and Middle River gate site.
Carquinez goldenbush *Isocoma arguta*	SC	–	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	Suitable habitat in project area. No CNDDB records within 5 miles of project area. Not observed during project area surveys.
Northern California black walnut (native stands) *Juglans californica* var. *hindsii*	SC	–	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.
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	SC	–	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	Population observed during project surveys in Middle River approximately 2.5 miles northwest of Middle River gate site.
Mason's lilaeopsis *Lilaeopsis masonii*	SC	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	Present throughout project area; observed during project surveys downstream of Middle River gate, at Grant Line Canal gate, at Old River at DMC gate, and at West Canal dredge area.

Species Name	Status [a]			Distribution	Preferred Habitats	Period Identifiable	Occurrence in the Project Area
	Federal	State	Other				
Delta mudwort *Limosella subulata*	–	–	2	Contra Costa, Sacramento, San Joaquin, and Solano Counties; Oregon; Atlantic coast	Intertidal marshes: sea level–10 feet	May–August	Several populations observed during project surveys along Middle River and Victoria and North Canals; several sites within West Canal dredging area.
Sanford's arrowhead *Sagittaria sanfordii*	SC	–	1B, CSC	Scattered locations in Central Valley and Coast Ranges	Freshwater marshes, sloughs, canals, and other slow-moving water habitats: sea level–1,850 feet	May–August	Marginally suitable habitat in project area; channels are probably too fast moving. Project area is 4 miles or more from a historical (1901) CNDDB record in Stockton and nearly 25 miles from a current CNDDB record (CNDDB 2003). Not observed during project area surveys.
Marsh skullcap *Scutellaria galericulata*	–	–	2	Northern high Sierra Nevada, Modoc plateau, and El Dorado, Nevada, Placer, Plumas, Shasta, and Siskiyou Counties	Wet sites, mesic meadows, streambanks, and coniferous forest: sea level–6,300 feet	June–September	Questionable habitat in project area. One recorded site, out of normal range for species, is 3 miles north of Middle River gate site (CNDDB 2003). Not observed during project area surveys.
Blue skullcap *Scutellaria lateriflora*	–	–	2	Northern San Joaquin Valley, east of Sierra Nevada, Inyo and San Joaquin Counties, New Mexico, and Oregon	Mesic meadows, marshes, and swamps: generally sea level–1,500 feet	July–September	Suitable habitat in project area. Would only include nontidal emergent wetland. No CNDDB records within 5 miles of project area. Not observed during project area surveys.

Species Name	Status [a] Federal	State	Other	Distribution	Preferred Habitats	Period Identifiable	Occurrence in the Project Area
Wright's trichocoronis *Trichocoronis wrightii* var.*wrightii*	–	–	2	Scattered locations in Central Valley and southern coast, Texas	Floodplains, moist places, drying river beds, and vernal lakes on alkaline soils: 15–1,300 feet	May–September	Questionable habitat in project area. Historical record presumed extant is approximately 3 miles upstream of the head of Old River fish gate site on San Joaquin River. Not observed during project area surveys.

Notes:

CNDDB = California Natural Diversity Database.

DMC = Delta-Mendota Canal.

Species included in this table are based on search results of the CNDDB (2004), lists provided by the U.S. Fish and Wildlife Service (USFWS) (2002), and field surveys conducted in the project area during 2000 and 2001. Only species from these sources with suitable habitat in the study area are included in this table.

[a] Status

– = not listed.

Federal

SC = USFWS Species of Special Concern.

State

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

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

Other

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

CALFED Bay-Delta Program (CALFED)

CSC = Other species of concern identified by CALFED.

caper-fruited tropidocarpum) were unsuccessful, and no specimens of either of these species were found at any sites surveyed. An attempt to locate occurrences of Delta tule pea on Grant Line Canal, as documented in the Interim SDIP EIR (California Department of Water Resources and Bureau of Reclamation 1996a), was also unsuccessful. A non-special-status variety of the species was observed in this area.

All observed populations of target special-status species were mapped using a GPS unit (Garmin 12XL, 1–15-meter accuracy, and CMT March II, 50-cm accuracy), and location data for all stands were stored in an ArcView GIS file.

Waters of the United States

The extent of waters of the United States were originally delineated and verified in the project area in 1994 (California Department of Water Resources and Bureau of Reclamation 1996a). In August and September 2001 and June and July 2003, DWR staff conducted a subsequent delineation of the project area. Wetlands were delineated according to the methods outlined in the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987), and other waters of the United States were identified based on the definition of waters of the United States (33 CFR Part 328). A preliminary delineation of potential dredged material disposal areas was conducted in November 2004.

A Corps wetland delineation datasheet was completed for representative sites of each mapped vegetation type (Appendix L). For the 2001 and 2003 delineation work, jurisdictional wetlands in riparian/streamside areas were delineated throughout the study area by extrapolating the wetland status of the representative vegetation types. This approach was approved by the Corps (Haley pers. comm.). The delineation information provided in this document is preliminary, pending verification by the Corps.

Environmental Conditions

Land Cover Types

Until the early 1800s, the south Delta consisted primarily of a mosaic of tidal marshland dominated by bulrushes (*Scirpus* sp.) with a few low, natural levees that supported woody riparian vegetation, grassland, and upland shrubs (Thompson 1957). The relatively small portions of native grassland and upland areas were among the first areas of the Delta Region to be converted to agricultural lands. Agriculture in the south Delta consisted primarily of dryland farming and land irrigated from artesian wells, groundwater pumping, and some creek canals. In the mid-1800s, levee construction increased, and marshland was drained to provide land for irrigated agriculture. By 1900, about one-half of the Delta’s historical wetland areas had been diked and drained. Extensive reclamation continued through the 1940s. Today, agricultural land dominates the south Delta. Some small, apparently natural islands remain in a quasinatural state, as do some in-channel islands that are remnants of dredging and levee construction.

Levees in the south Delta typically have waterside slopes that are fully covered with riprap and are actively maintained, which includes regular herbicide application to control vegetation that could destabilize the levee structure. As a result, there is little or no vegetation or exposed substrate on the actual levees, with the common exception of a fringe at the outside levee toe that is typically very sparsely vegetated and does not support special-status species. Interior areas of most south Delta islands are actively farmed and contain little or no natural (uncultivated) vegetation. Consequently, most remaining undisturbed plant communities and most occurrences of special-status species occur on in-channel islands with no levees.

In the study area, land cover types can be divided into artificial and natural vegetation communities, aquatic communities, and developed land. Agriculture and landscaping are artificial vegetation communities because they are maintained. The other vegetation communities and the aquatic communities are natural community types. Land cover types present in the study area are subtypes of the NCCP communities addressed in the MSCS (CALFED Bay-Delta Program 2000e). The land cover types mapped in the study area are listed in Table 6.2-1 and are discussed below. Table 6.2-1 correlates the MSCS NCCP communities, where applicable, with the land cover types used in this document. Table 6.2-1 also includes the extent of each land cover type as mapped throughout the study area. Gate site acreages in Table 6.2-1 include areas within boundaries drawn around the upstream and downstream extent of dredging, as well as the farthest inland extent on both sides of the channel that were identified in project construction drawings (boundaries shown as *Project Area* in Figures 6.2-2–6.2-5).

Tidal Perennial Aquatic

Tidal perennial aquatic habitat is characterized by open water and is defined as deepwater aquatic (i.e., greater than 3 meters [10 feet] deep from mean low tide), shallow aquatic (i.e., less than or equal to 3 meters [10 feet] deep from mean low tide), and unvegetated intertidal (i.e., tidal flats) zones of estuarine bays, river channels, and sloughs (CALFED Bay-Delta Program 2000e). In the south Delta project area, tidal perennial aquatic habitat includes sloughs, channels, and flooded islands. Deep open-water areas are largely unvegetated, and beds of aquatic plants occasionally occur in shallower open-water areas.

Tidal perennial aquatic habitat is present throughout the project area, including all gate sites and dredge areas (Figures 6.2-2–6.2-8). Typical tidal perennial aquatic plant species include water hyacinth, water primrose, Brazilian waterweed, common waterweed, hornwort, parrot's feather, and western milfoil. Colonies of these aquatic plants are generally infrequent, but mats of noxious weeds, such as water hyacinth or Brazilian waterweed, can clog waterways, shade habitat for native aquatic vegetation, and smother low-growing intertidal vegetation when washed onto channel banks (California Exotic Pest Plant Council 1999; California Department of Boating and Waterways 2000, 2001). Vegetation, when present, is generally restricted to waterways with low water velocities and areas with low levels of disturbance.

Tidal perennial aquatic habitats 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 tidal perennial aquatic habitat in the project area.

Tule and Cattail Tidal Emergent Wetland

The tule and cattail tidal emergent wetland community includes portions of the intertidal zones of the Delta that support emergent wetland plant species that are not tolerant of saline or brackish conditions. Tidal emergent wetland includes all or portions of the freshwater emergent wetland tidal and Delta sloughs and in-channel islands and shoals habitats (CALFED Bay-Delta Program 2000e). This community type occurs on in-channel islands and along mostly unleveed, tidally influenced waterways and qualifies as jurisdictional wetland under Section 404 of the CWA.

The tule and cattail tidal emergent wetland community occurs along all channels and most in-channel islands in the project area. This habitat occurs on the south bank and in-channel island at the Grant Line Canal site (Figure 6.2-4) and on the south bank of the Old River at DMC gate site (Figure 6.2-5). This tidal emergent wetland is also present on the east bank of the West Canal dredging area (Figure 6.2-6) and more extensively in the Middle River and Old River dredging areas (Figures 6.2-7 and 6.2-8).

Tules and cattails, along with common reed, buttonbush, sedges, and rushes, dominate the tule and cattail tidal emergent wetland community. This wetland community provides suitable habitat for the following special-status species: Suisun Marsh aster, slough thistle, rose-mallow, Delta tule pea, Mason’s lilaeopsis, and Delta mudwort. Of these species, rose-mallow, Mason’s lilaeopsis, and Delta mudwort were observed in the project area (Table 6.2-2 and Figure 6.2-9).

Cottonwood-Willow Woodland

The cottonwood-willow woodland community typically occurs on channel islands, on levees, and along unmaintained channel banks of south Delta sloughs and rivers. The riparian zone along leveed islands is usually very narrow, but more extensive riparian areas occur on in-channel islands or other unleveed areas. Cottonwood-willow woodland occurs at the proposed Middle River, Grant Line Canal, and Old River at DMC gate sites.

Cottonwood-willow woodland occurs on an in-channel island at the proposed Middle River gate site (Figure 6.2-3) and is dominated by mature black willow with an understory of shrubs, including California button-willow, sandbar willow, shining willow, and California rose.

Cottonwood-willow woodland at the proposed Grant Line Canal gate site (Figure 6.2-4) is dominated by a mature stand of Fremont cottonwood that forms a nearly contiguous overstory and intergrades with tule and cattail tidal emergent marsh, riparian scrub, and willow scrub. Dominant understory species include black willow, sandbar willow, and shining willow. Other understory species include Himalayan blackberry, California blackberry, California button-willow, Indian hemp, California rose, coyote brush, and California black walnut. Herbaceous cover occurs where shrubs are sparse or absent and includes Santa Barbara sedge, hoary nettle, creeping wildrye, bracken fern, and hedge-nettle. Disturbed portions of the cottonwood-willow woodland at the Grant Line Canal site support many nonnative species or species introduced from elsewhere in the state, including Monterey pine, coast redwood, Modesto ash, Canary Island pine, acacia, tree of heaven, Aleppo pine, and gum tree. Herbaceous cover in disturbed sites includes ruderal species such as Italian thistle, ripgut brome, milk thistle, periwinkle, and poison hemlock.

The Old River at DMC gate site supports patches of cottonwood-willow woodland on both banks (Figure 6.2-5). This woodland includes scattered Fremont cottonwood on the levee bank with a ruderal understory.

Within the West Canal dredging area, cottonwood-willow woodland dominates an in-channel island and occurs in patches on banks (Figure 6.2-6). This woodland also occurs extensively in both the Middle River and Old River dredging areas and on proposed dredged material disposal sites DS-2 and DS-3 on Roberts Island (Figures 6.2-7 and 6.2-8).

Areas of cottonwood-willow woodland growing on in-channel islands or on levee banks within the high tide line may qualify as jurisdictional wetlands under Section 404 of the CWA and as waters under the Rivers and Harbors Act, and are referred to in this chapter as cottonwood-willow woodland wetland. DFG considers riparian communities such as cottonwood-willow woodland to be rare natural communities and maintains a current list of these communities throughout the state in the CNDDB (California Natural Diversity Database 2004).

Cottonwood-willow woodland is suitable habitat for the following special-status plants: western leatherwood, Loma Prieta hoita, and native stands of northern California black walnut. None of these plants, or stands of walnut, were observed in the project area (Table 6.2-2).

Valley Oak Riparian Woodland

Valley oak riparian woodland includes areas where the dominant overstory is valley oak. Associate species are similar to those described for the cottonwood-willow woodland vegetation. This riparian woodland also occurs on banks and on in-channel islands in the study area.

Within the project area, valley oak riparian woodland occurs within the Middle River and Old River dredge areas and on dredged material disposal site DS-2 (Figures 6.2-7 and 6.2-8).

Areas of valley oak riparian woodland growing on in-channel islands or on levee banks within the high tide line may qualify as jurisdictional wetlands under Section 404 of the CWA and as waters under the Rivers and Harbors Act, and are referred to in this chapter as valley oak riparian woodland wetland. DFG considers riparian communities such as valley oak riparian woodland to be rare natural communities and maintains a current list of these communities throughout the state in the CNDDB (California Natural Diversity Database 2004).

Valley oak riparian woodland is suitable habitat for the same special-status plants as listed above for cottonwood-willow woodland.

Riparian Scrub

The riparian scrub community is dominated by dense stands of shrubs, such as California button-willow, wild rose, Himalayan blackberry, and white alder. Where shrub cover is absent, herbaceous cover is often abundant and includes Indian hemp, yellow iris, centaury, vervain, umbrella sedge, creeping bent grass, bugleweed, and hedge-nettle.

Riparian scrub also includes blackberry thickets, which intergrade with riparian habitats. These thickets are characteristically monotypic stands of Himalayan blackberry, with scattered and isolated trees and shrubs, including coyote brush, sandbar willow, shining willow, and white alder. Blackberry thickets occur in association with ruderal habitats; however, an herbaceous understory is not evident within these thickets. Elderberry shrubs may also be associated with this community type and are numerous at the DS-2 dredged material disposal site.

Riparian scrub vegetation occurs throughout the project area. Blackberry thickets occur on levee banks at the Middle River, Grant Line Canal, and Old River at DMC gate sites and on the in-channel island at Grant Line Canal (Figures 6.2-3–6.2-5). Riparian scrub also occurs at all three potential dredging areas and at dredged material disposal sites DS-2 and -3 on Roberts Island (Figures 6.2-6–6.2-8).

Areas of riparian scrub on in-channel islands or on levee banks within the high tide line may qualify as jurisdictional wetland under Section 404 of the CWA and as waters under the Rivers and Harbors Act, and are referred to in this chapter as riparian scrub wetlands. DFG considers riparian communities such as riparian scrub to be rare natural communities and maintains a current list of these communities throughout the state in the CNDDB (California Natural Diversity Database 2004).

Riparian scrub is suitable habitat for the following special-status plants: western leatherwood, Delta coyote-thistle, slough thistle, and Loma Prieta hoita.

Willow Scrub

Willow scrub is a type of riparian scrub habitat dominated by willow species, particularly sandbar willow and young trees of other willow species, such as shining willow and black willow. In disturbed areas, willow scrub intergrades with blackberry vegetation.

Willow scrub occurs at the Grant Line Canal gate site on the in-channel island (Figure 6.2-4), on the south bank at the Old River at DMC gate site (Figure 6.2-5), in the three proposed dredge areas, and at dredged material disposal sites DS-2 and DS-3 on Roberts Island (Figures 6.2-6–6.2-8).

Areas of willow scrub growing on in-channel islands or on levee banks within the high tide line may qualify as jurisdictional wetlands under Section 404 of the CWA and as waters under the Rivers and Harbors Act, and are referred to in this chapter as willow scrub wetland. DFG considers riparian communities such as willow scrub to be rare natural communities and maintains a current list of these communities throughout the state in the CNDDB (California Natural Diversity Database 2004).

Willow scrub is suitable habitat for the same special-status plants as listed above for riparian scrub.

Agricultural Ditch

Ditches are present throughout much of the project area on the landside of the levees, but because avoidance of these features is assumed for most project activities, they were mapped only within the proposed dredged material disposal sites on Roberts Island. Ditches are either cement-lined or earth-lined.

Earth-lined agricultural ditches in the project area are typically installed, removed, and maintained periodically as part of routine farming practices. Most of these ditches are shallow and do not intersect the water table. These ditches are generally saturated or ponded for long durations; however, the water is pumped on and off as needed as part of routine farming operations (irrigation). Because water is present for long durations, ditches may exhibit wetland characteristics. They are, however, created features with an artificial water source and are considered jurisdictional only if water is pumped from the ditch to waters of the United States. This circumstance occurs in one ditch on DS-4 where water is pumped from the ditch to Middle River. This ditch supports wetland species, such as sorghum, knotweed, cocklebur, hyssop loosestrife, sprangle-top, and nutsedge.

Because these features have been excavated and are generally subject to maintenance, they have minimal suitable habitat for special-status plants but have potential to support rose-mallow.

Giant Reed Stand

Areas mapped as giant reed stands in the project area are monotypic stands of giant reed (*Arundo donax*), a noxious weed that is particularly invasive in riparian habitats. Giant reed stands have been mapped at the Old River at DMC site and in the three dredging areas (Figures 6.2-5 and 6.2-6–6.2-8). No special-status plant species are known to occur in giant reed stands and are likely to be excluded from establishing within the areas invaded by giant reed.

Agriculture

Agriculture habitat includes agricultural lands that are not seasonally flooded. Major crops and cover types in agricultural production include small grains (such as wheat and barley), field crops (such as corn, sorghum, and safflower), truck crops (such as tomatoes and sugar beets), forage crops (such as hay and alfalfa), pastures, orchards, and vineyards. The distribution of seasonal crops varies annually, depending on crop-rotation patterns and market forces. Recent agricultural trends in the Delta include an increase in the acreage of orchards and vineyards. General cropping practices result in monotypic stands of vegetation for the growing season and bare ground in the fall and winter. In areas not intensively cultivated, such as fallow fields, roads, ditches, and levee slopes, regular maintenance precludes the establishment of ruderal vegetation or native vegetation communities.

Agricultural irrigation ditches are a part of most of the agricultural fields in the south Delta. Because the habitat provided by agricultural ditches is different from that of agricultural fields, it is described separately (see above). While agriculture is present throughout much of the project area on the land-side of the levees, it has only been included in the project area mapping at the proposed flow control and fish control gate sites and within the proposed dredged material disposal sites on Roberts Island and Stewarts Tract.

No special-status plant species are known in agriculture habitat because of the soil disturbance inherent in the agricultural practices of the south Delta.

Developed Land

Developed land mapped in the project area includes areas with roads and buildings but also includes barren areas that have been disturbed and are unvegetated. These areas occur along riprapped levee faces and at the tops of levees. Developed land is mapped at all four of the proposed gate sites. No special-status plant species are known to occur in developed land areas because most vegetation has been removed, and these areas remain highly disturbed.

Landscaping

Landscaping includes areas that have been planted with ornamental, usually nonnative, vegetation and turf grasses. A minimal amount of this cover type occurs in the project area and is mapped only on the south bank of Old River west of the Old River at DMC gate site. Because of the disturbance related to installation of landscaping and the ongoing maintenance of these areas, no special-status plant species are expected to occur in landscaped areas.

Ruderal

Areas mapped as ruderal vegetation in the study area are dominated by herbaceous, nonnative, weedy species and may support stands of noxious weeds. Ruderal vegetation generally occurs in disturbed areas, such as levee faces and edges of agricultural fields and roads. Ruderal vegetation is extensive on the land-side levee faces at the Middle River and Old River at DMC gate sites (Figures 6.2-3 and 6.2-5). The entire north bank of the Grant Line Canal site is ruderal, as are patches on the in-channel island (Figure 6.2-4). The head of Old

River fish control gate site supports primarily ruderal vegetation (Figure 6.2-2). Ruderal vegetation also occurs within the proposed dredges areas, particularly at the south end of the Middle River dredge area (Figure 6.2-3). Ruderal vegetation generally occurs in areas subject to periodic disturbances, and the species in this land cover type are generally weedy to invasive. For these reasons, no special-status plants are expected to occur in ruderal vegetation communities.

Special-Status Plants

Special-status plant species are species legally protected under 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, available at: <www.cnps.org/rareplants/inventory/6thEdition/htm>); 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, available at: <www.cnps.org/rareplants/inventory/6thEdition/htm>), which may be included as special-status species on the basis of local significance or recent biological information.

The following species from the consolidated list described above ("Special-Status Plants") do not have suitable habitat or the appropriate elevation range in the project area, are not included in Table 6.2-2, and will not be further addressed in this document:

- large-flowered fiddleneck *Amsinckia grandiflora*
- bent-flowered fiddleneck *Amsinckia lunaris*
- pallid manzanita *Arctostaphylos pallida*
- coast rock cress *Arabis blepharophylla*
- alkali milkvetch *Astragalus tener* var. *tener*

- heartscale — *Atriplex cordulata*
- San Jacinto Valley crownscale — *Atriplex coronata* var. *notatior*
- brittlescale — *Atriplex depressa*
- San Joaquin saltbush — *Atriplex joaquiniana*
- chaparral harebell — *Campanula exigua*
- bristly sedge — *Carex comosa*
- succulent owl's-clover — *Castilleja campestris* ssp. *succulenta*
- Lemmon's jewelflower — *Caulanthus coulteri* var. *lemmonii*
- Franciscan thistle — *Cirsium andrewsii*
- soft bird's-beak — *Cordylanthus mollis* ssp. *mollis*
- Mt. Diablo bird's-beak — *Cordylanthus nidularius*
- palmate-bracted bird's-beak — *Cordylanthus palmatus*
- Hoover's cryptantha — *Cryptantha hooveri*
- Livermore tarplant — *Deinandra bacigalupii*
- Hospital Canyon larkspur — *Delphinium californicum* ssp. *interius*
- recurved larkspur — *Delphinium recurvatum*
- western leatherwood — *Dirca occidentalis*
- Tiburon buckwheat — *Eriogonum luteolum* var. *caninum*
- Ben Lomond buckwheat — *Eriogonum nudum* var. *decurrens*
- round-leaved filaree — *Erodium macrophyllum*
- Contra Costa wallflower — *Erysimum capitatum* ssp. *angustatum*
- diamond-petaled California poppy — *Eschscholzia rhombipetala*
- stinkbells — *Fritillaria agrestis*
- fragrant fritillary — *Fritillaria liliacea*
- serpentine bedstraw — *Galium andrewsii* ssp. *gatense*
- Boggs Lake hedge-hyssop — *Gratiola heterosepala*
- Diablo helianthella — *Helianthella castanea*
- Brewer's western flax — *Hesperolinon breweri*
- Loma Prieta hoita — *Hoita strobilina*
- Santa Cruz tarplant — *Holocarpha macradenia*
- Contra Costa goldfields — *Lasthenia conjugens*
- showy madia — *Madia radiata*
- Hall's bush mallow — *Malacothamnus hallii*

- Oregon meconella — *Meconella oregana*
- robust monardella — *Monardella villosa* ssp. *globosa*
- little mousetail — *Myosurus minimus* ssp. *apus*
- Antioch Dunes evening-primrose — *Oenothera deltoides* ssp. *howellii*
- Gairdner's yampah — *Perideridia gairdneri* ssp. *gairdneri*
- Mt. Diablo phacelia — *Phacelia phacelioides*
- rock sanicle — *Sanicula saxatilis*
- most beautiful jewel-flower — *Streptanthus albidus* ssp. *peramoensus*
- Mt. Diablo jewelflower — *Streptanthus hispidus*
- caper-fruited tropidocarpum — *Tropidocarpum capparideum*
- Greene's tuctoria — *Tuctoria greenei*

The following section discusses special-status plant species that have been documented in the project area and identifies additional special-status species that have the potential to occur in the project area.

Table 6.2-2 includes a list of special-status plants that have suitable habitat in the project area, occur in the project region, and/or were observed in the study area. The table includes the plant species name, status, habitat, and occurrence in the project area. Figure 6.2-9 identifies the locations of all CNDDB records for special-status plants within 5 miles of the study area.

Four special-status plant species have been documented during botanical surveys of the study area: rose-mallow, Delta tule pea, Mason's lilaeopsis, and Delta mudwort. These species were not regularly dispersed but were found in clusters that correlate with the presence of in-channel islands with unmanaged habitat (i.e., not leveed, farmed, riprapped, or along setback levees) (Figure 6.2-10). Gate sites are primarily active agricultural fields or unmanaged disturbed land on levee faces. The Grant Line Canal site was the only gate site that contained special-status plants.

The special-status species discussed below include the three species that either were found during the 2000–2001 field surveys (i.e., rose-mallow, Mason's lilaeopsis, and Delta mudwort) or that are covered species in the ASIP (SDIP ASIP) for which there is suitable habitat in the project area.

Suisun Marsh Aster

Suisun Marsh aster is a perennial herb that occurs in brackish and freshwater marsh habitat along tidal sloughs and rivers, usually at or near the water's edge, or in drainage and irrigation ditches (California Native Plant Society 2001; California Department of Water Resources 1994c). This species was not found in the study area during the 2000–2001 surveys. The nearest CNDDB-recorded occurrence of Suisun Marsh aster includes two locations at the confluence of Old River and Rock Slough, more than 5 miles north of the proposed dredging area

(California Natural Diversity Database 2004). One location is on an in-channel island, and the other is on the slough bank. The plants occur in tidal marsh habitat in association with goldenrod, blackberry, dallisgrass, and pampas grass. Only 10 plants were observed at this occurrence in 1986.

Slough Thistle

Slough thistle is an annual herb endemic to Kern, King, and San Joaquin Counties, with 17 known occurrences (California Natural Diversity Database 2004). Population sizes of slough thistle appear to fluctuate widely from year to year (California Native Plant Society 2001). Slough thistle occurs in emergent wetland, riparian scrub, and chenopod scrub habitats. This species was not found in the study area during the 2000–2001 surveys, but a potentially extirpated population was last seen in 1933 at the confluence of Old River and San Joaquin River in an area of intensive agriculture (California Natural Diversity Database 2004).

Delta Coyote-Thistle

Delta coyote-thistle is an annual to perennial herb that occurs in seasonally wet depressions within riparian scrub habitats. This species was not found in the study area during the 2000–2001 surveys, although suitable riparian scrub and willow scrub habitat is present. The species is recorded within 1 mile of the project area, in an area that floods and is occupied by a walnut orchard, but may have been extirpated (California Natural Diversity Database 2004).

Rose-Mallow

Rose-mallow is an herbaceous perennial that spreads by rhizomes within freshwater marsh habitat. This species was recorded at approximately 36 sites during the 2000–2001 special-status plant surveys, including populations along Middle River downstream of the proposed gate near the confluence with Victoria and North Canals, and on West Canal, Grant Line Canal, and Fabian and Bell Canal (Figure 6.2-10). In the study area, this species was observed to occur primarily on clay banks in the intertidal zone from the 0 tide level to mean high tide and to tolerate erosion until roots were exposed and it was washed away (Witzman personal observation).

Delta Tule Pea

Delta tule pea is a perennial herb that occurs along tidal sloughs, riverbanks, and levees near the water’s edge. Some populations are partially inundated at high tide (California Department of Water Resources 1994c). This species was at one site on Middle River approximately 2 miles north of the proposed gate site during the 2000–2001 special-status plant surveys. Delta tule pea was also previously reported in the study area in the ISDP EIR (California Department of Water Resources and Bureau of Reclamation 1996a). The previously reported occurrence was located in tidal emergent wetland on the south side of the in-channel island on Grant Line Canal upstream of the proposed gate site. The closely related *Lathyrus jepsonii* var. *californicus* was observed in this area during the 2000–2001 surveys. The nearest CNDDB-recorded occurrence is located approximately 3 miles northeast of the project area on an in-channel island in Middle River (California Natural Diversity Database 2004). Habitat at this location is emergent marsh adjacent to tule marsh.

Mason's Lilaeopsis

Mason's lilaeopsis is a diminutive rhizomatous perennial herb that typically occurs on clay or silt tidal mudflats with high organic matter content (Golden and Fiedler 1991). The lilaeopsis occurs in the lower reach of the Napa River and throughout the Delta. The project area is located at the southernmost extent of its range. Mason's lilaeopsis was recorded at approximately 175 sites during the 2000–2001 special-status plant surveys, including populations along Old River within the proposed dredging area and upstream of the proposed gate, West Canal, Victoria and North Canals, Grant Line Canal, Fabian and Bell Canal, and Middle River downstream of the proposed gate (Figure 6.2-10). These locations of Mason's lilaeopsis occur on in-channel islands and unmanaged habitat.

Mason's lilaeopsis lives almost exclusively in intertidal locations where it is inundated twice each day by high tides for varying periods of time during each month (Golden and Fiedler 1991; Zebell and Fiedler 1996). This species appears to become less abundant as tidal range decreases. For example, the map of Mason's lilaeopsis occurrences in the south Delta (Figure 6.2-10) shows that the frequency of occurrences decreases with distance from the Carquinez Strait (source of tidal water and the direction in which tidal range increases). In addition, previous monitoring studies of Mason's lilaeopsis in Old River near the temporary barrier recorded that Mason's lilaeopsis populations shrank or disappeared upstream of the barrier over the 2-year monitoring period but were essentially unaffected below the barrier (California Department of Water Resources 1999c, 2001b). These facts implicate tidal fluctuation as an important factor in determining Mason's lilaeopsis abundance and suggest that decreased tidal range is having an adverse effect on existing populations.

Mason's lilaeopsis populations generally occur at elevations varying from approximately 0.5 to 2 feet NGVD (California Department of Fish and Game 1995a; California Department of Water Resources 2001b). Locations of this species can vary from year to year because of the transient nature of the mudflat habitat on which it grows. Both lack of siltation and accelerated erosion can remove habitat and individual plants. Mason's lilaeopsis successfully tolerates disturbance because it spreads vegetatively by rhizomes. No seedlings were observed during a survey of the entire range of Mason's lilaeopsis, although small tufts were seen floating in the Delta region, indicating that the lilaeopsis may colonize sites by the dispersal of vegetative mats through the Delta waterways (Golden and Fielder 1991).

The instability of Mason's lilaeopsis habitat on mudflats may reduce competition from other larger species (Zebell and Fiedler 1996). However, the lilaeopsis is subject to competition, particularly by water hyacinth in the San Joaquin River region (Golden and Fiedler 1991; Zebell and Fiedler 1996). Water hyacinth negatively affects Mason's lilaeopsis through competition for light, obstruction of habitat, prevention of colonization, and physical disturbance when washed onto the shoreline by wave action (Zebell and Fiedler 1996). Pampas grass may also threaten the lilaeopsis (Golden and Fiedler 1991).

Mason's lilaeopsis occurs in habitats with water salinity from 0.25 up to 8.5 ppt and may tolerate even higher salinities (Golden and Fiedler 1991; Zebell and Fiedler 1996); however, growth and sexual reproduction may be depressed at higher salinity levels (Fiedler and Zebell 1993). Experiments on the response of Mason's lilaeopsis to crude oil at varying salinities indicate that crude oil significantly affects aboveground growth at salinity levels above 0 ppt (Zebell and Fiedler 1996).

DWR purchased mitigation credits at the Kimball Island Mitigation Bank for impacts on Mason's lilaeopsis resulting from implementation of the South Delta Temporary Barriers Project. Impacts on Mason's lilaeopsis were concluded to be attributable to operation of the temporary barriers, which caused an increase in the low-tide level upstream of the barriers. The increased low-tide level caused long-term inundation and loss of the Mason's lilaeopsis at monitored sites (California Department of Water Resources 2001b).

Delta Mudwort

Delta mudwort is a low-growing, herbaceous perennial that occurs on muddy or sandy intertidal flats, sometimes in association with Mason's lilaeopsis (California Native Plant Society 2001; Golden and Fiedler 1991). Delta mudwort was recorded at approximately 40 sites during the 2000–2001 special-status plant surveys, including populations along Middle River and Victoria and North Canals and at several sites within the West Canal dredging area (Figure 6.2-10). During previous surveys conducted in support of the ISDP EIR, Delta mudwort was also found on Grant Line Canal growing in association with Mason's lilaeopsis (California Department of Water Resources and Bureau of Reclamation 1996a).

Delta mudwort likely has similar habitat requirements to those described above for Mason's lilaeopsis, but the mudwort is more sensitive to high salinity levels (Zebell and Fiedler 1996).

Waters of the United States

Based on DWR's preliminary wetland delineation data, there are minimal areas of jurisdictional wetlands along the leveed channels in the study area. Levees are generally covered with riprap and provide few areas with hydrology or soil needed for wetland plant growth. In-channel islands have a higher likelihood of containing jurisdictional wetlands because there are more areas appropriate to plant growth that have exposed soil and are regularly flooded. Land cover types that are considered waters of the United States include:

- tidal perennial aquatic,
- tule and cattail tidal emergent wetland; and

- cottonwood-willow woodland wetland, riparian scrub wetland, and willow scrub wetland growing on in-channel islands.

The dominant plant species and locations of these land cover types are described above in "Land Cover Types." Preliminary acreages of tidal perennial aquatic habitat and each jurisdictional wetland type in the project area are given in Table 6.2-3. The final acreage of jurisdictional waters of the United States, including wetlands, in the project area is subject to verification by the Corps.

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 SDIP. Certain local, state, and federal regulations require issuance of permits before project implementation; other regulations require agency consultation but may not require issuance of any entitlements before project implementation. The SDIP's requirements for permits and environmental review and consultation may change during the EIS/EIR review process, as discussions with involved agencies proceed.

Federal Requirements

Endangered Species Act

Section 7 of the ESA requires federal agencies, in consultation with USFWS and/or NOAA Fisheries, to ensure that their actions do not jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of these species. The required steps in the Section 7 consultation process are as follows:

- Agencies must request information from USFWS and/or NOAA Fisheries on the existence in a project area of special-status species or species proposed for listing.
- Following receipt of the USFWS/NOAA Fisheries response to this request, agencies generally prepare a BA to determine whether any special-status species or species proposed for listing are likely to be affected by a proposed action.
- Agencies must initiate formal consultation with USFWS and/or NOAA Fisheries if the proposed action might adversely affect special-status species.
- USFWS and/or NOAA Fisheries must prepare a BO to determine whether the action would jeopardize the continued existence of special-status species or adversely modify their critical habitat.
- If a finding of jeopardy or adverse modifications is made in the BO, USFWS and/or NOAA Fisheries must recommend reasonable and prudent alternatives that would avoid jeopardy, and the federal agency must modify

Table 6.2-3. Acreage of Waters of the United States Delineated in Each Project Component Area[1]

	Acreage at Gate Sites				Acreage at Dredging Areas				
Land Cover Type	Middle River Flow Control Gate	Grant Line Canal Flow Control Gate	Old River at DMC Flow Control Gate	Head of Old River Fish Control Gate	West Canal Conveyance Dredging Area	Middle River Conveyance Dredging Area	Old River Conveyance Dredging Area	Spot Dredging Areas for Agricultural Diversions	Acreage at Dredge Material Disposal Sites
Tidal perennial aquatic	8.10	10.40	3.74	7.58	73.02	72.67	123.46	477.27	0
Tule and cattail tidal emergent wetland	0045	0.27	0.39	0	3.12	6.60	8.01	29.04	0
Cottonwood-willow woodland wetland	0.42	1.79	0.03	0	11.45	21.57	57.81	81.94	0
Riparian scrub wetland	0.66	1.02	0.94	0	0.32	13.73	16.51	20.33	0
Willow scrub wetland	0	0.13	0.05	0	1.52	6.40	24.75	21.16	0
Agricultural ditch	0	0	0	0	0	0	0	0	0.4
Total	**9.63**	**13.61**	**5.08**	**7.58**	**89.43**	**120.97**	**230.54**	**629.74**	**0.4**
Total wetlands in each project component area	**1.53**	**3.21**	**1.41**	**0**	**16.41**	**48.30**	**107.08**	**152.47**	**0**
Total other waters of the United States in each project component area	**8.1**	**10.40**	**3.67**	**7.58**	**73.02**	**72.67**	**123.46**	**477.27**	**0.40**

Total Wetlands = 330.41 acres

Total Other Waters = 776.64 acres

Notes:

DMC = Delta-Mendota Canal.

[1] Acreages shown in this table are rounded to the nearest 0.01 acre, rather than 0.1 acre as in Table 6.2-1. Acreages are preliminary and are subject to verification by the U.S. Army Corps of Engineers.

the project to ensure that special-status species are not jeopardized and that their critical habitat is not adversely modified (unless an exemption from this requirement is granted).

In the preparation of the SDIP EIR/EIS, the MSCS approach was used and an ASIP, serving as the equivalent to the CALFED Programmatic SDIP BA, has been prepared in compliance with Section 7 of the ESA.

Clean Water Act Section 404(b)(1) Guidelines and Section 401

Section 404. Section 404 of the CWA requires that a permit be obtained from the Corps for discharges of dredged or fill material into "waters of the United States, including wetlands." Waters of the United States include wetlands and lakes, rivers, streams, and their tributaries. Wetlands are defined for regulatory purposes, at 33 CFR 328.3 and 40 CFR 230.3, as areas inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

CWA Section 404(b) requires that the Corps issue permits in compliance with guidelines developed by EPA. These guidelines require that an analysis of alternatives be available to meet the project purpose and need, including those that avoid and minimize discharges of dredged or fill material in waters. Once this has been completed, the project that is permitted must be the least environmentally damaging practical alternative before the Corps may issue a permit for the proposed activity.

Actions typically subject to Section 404 requirements are those that would take place in waters of the United States, including wetlands and stream channels, including intermittent streams, even if they have been realigned. Within stream channels, a permit under Section 404 would be needed for any discharge activity below the ordinary high-water mark, which is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, or the presence of litter or debris.

The Programmatic ROD for the CALFED Final Programmatic EIS/EIR includes a CWA Section 404 MOU signed by Reclamation, EPA, the Corps, and DWR. Under the terms of the MOU, when a project proponent applies for a Section 404 individual permit for CALFED projects, the proponent is not required to reexamine program alternatives already analyzed in the Programmatic EIS/EIR. The Corps and EPA will focus on project-level alternatives that are consistent with the Programmatic EIS/EIR when they select the least environmentally damaging practicable alternative at the time of a Section 404 permit decision.

Note: CWA Section 404 jurisdiction includes areas regulated under the Rivers and Harbors Act Section 10. The Corps typically combines Section 10 and Section 404 into one permitting process.

Section 401. Under CWA Section 401, applicants for a federal license or permit to conduct activities that may result in any discharge into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect state water quality (including projects that require federal agency approval [such as issuance of a Section 404 permit]) must also comply with CWA Section 401. In California, the authority to grant water quality certification has been delegated to the State Water Board, and applications for water quality certification under CWA Section 401 are typically processed by the RWQCB with local jurisdiction. Water quality certification requires evaluation of potential impacts in light of water quality standards and CWA Section 404 requirements governing discharge of dredged and fill materials into waters of the United States.

For purposes of this project, Reclamation will obtain certification from the Central Valley RWQCB under Section 401 of the CWA.

River and Harbors Appropriation Act of 1899

The River and Harbors Appropriation Act of 1899 addresses activities that involve the construction of dams, bridges, dikes, and other structures across any navigable water. Placing obstructions to navigation outside established federal lines and excavating from or depositing material in such waters require permits from the Corps. In the Corps Sacramento District, navigable waters of the United States in the project area that are subject to the requirements of the River and Harbors Appropriation Act are Middle River, San Joaquin River, Old River, and all waterways in the Sacramento–San Joaquin drainage basin affected by tidal action (U.S. Army Corps of Engineers 2003). Sections of the River and Harbors Act applicable to the SDIP are described below.

Section 9. Section 9 (33 USC 401) prohibits the construction of any dam or dike across any navigable water of the United States in the absence of Congressional consent and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the water body lie wholly within the limits of a single state, the structure may be built under authority of the legislature of that state, if the location and plans or any modification thereof are approved by the Chief of Engineers and the Secretary of the Army.

Section 10. Section 10 (33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section provides that the construction of any structure in or over any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters, is unlawful unless the work has been recommended and authorized by the Chief of Engineers.

Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 (May 24, 1977) requires federal agencies to prepare wetland assessments for proposed actions located in or affecting wetlands. Agencies must avoid undertaking new construction in wetlands unless no practicable alternative is available and the proposed action includes all practicable measures to minimize harm to wetlands. This chapter of the EIS/EIR describes impacts on wetlands and mitigation measures for reducing significant impacts.

State Requirements

California Endangered Species Act

CESA requires a state lead agency to consult formally with DFG when a proposed action may affect state-listed endangered or threatened species. The provisions of the ESA and CESA will often be activated simultaneously. The assessment of project effects on species listed under both the ESA and CESA is addressed in USFWS's and NOAA Fisheries' BOs. However, for those species listed only under CESA, DWR must formally consult with DFG, and DFG must issue a BO separate from USFWS's BO.

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.

State Regional Water Quality 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.

Section 1602 of the California Fish and Game Code

DFG regulates work that will substantially affect resources associated with rivers, streams, and lakes in California, pursuant to Fish and Game Code Sections

1600–1607. Any action from a public project that substantially diverts or obstructs the natural flow or changes the bed, channel, or bank of any river, stream, or lake or uses material from a streambed must be previously authorized by DFG in a Lake or Streambed Alteration Agreement under Section 1602 of the Fish and Game Code. This requirement may, in some cases, apply to any work undertaken within the 100-year floodplain of a body of water or its tributaries, including intermittent streams and desert washes. As a general rule, however, it applies to any work done within the annual high-water mark of a wash, stream, or lake that contains or once contained fish and wildlife or that supports or once supported riparian vegetation.

Activities associated with the SDIP that require Section 1602 authorization and a Streambed Alteration Agreement include the modification and setting back of existing levees, placement of fish and flow control gates, and conveyance improvements. These actions would result in the alteration of the flow within water bodies and occur within the annual high-water mark of water bodies that contain wildlife and support riparian vegetation.

The current temporary barriers program operates under DFG Section 1602 authorization. This EIS/EIR will be used as the CEQA review document by DWR as part of a new permit application, submitted to DFG for either continued authorization of activities under the existing agreement or for the issuance of a new Streambed Alteration Agreement (California Fish and Game Code 1600 *et seq.*).

Environmental Consequences

Impact Assessment Methods

Impact Mechanisms

Vegetation and wetland resources could be directly or indirectly affected by the SDIP. The following types of activities could cause varying degrees of impacts on these resources:

- vegetation removal, grading, and paving activities during gate construction, building activities, dredging, and siphon extensions;
- channel dewatering or installation of temporary water-diversion structures;
- temporary stockpiling and sidecasting of soil, construction materials, or other construction wastes;
- soil compaction, dust, and water runoff from the construction site into adjacent areas;
- introduction of invasive nonnative species in construction areas that could displace native plant species in adjacent open space areas;
- burying of vegetation under riprap used for bank stabilization near the gates;

- dredging activities in wetlands and channels that contain ponded or flowing water and saturated soils;
- disposal of dredged material on the waterside of levee banks or adjacent to the landside of levees;
- runoff of herbicides, fertilizers, diesel, gasoline, oil, raw concrete, and other toxic materials used for gate construction and maintenance into sensitive resource areas (e.g., wetlands, streams, special-status plant populations); and
- alteration of the tidal range and water levels during increased diversions into CCF, seasonally increased pumping at the SWP Banks facility, and operation of the gates that could result in the inundation or stranding of vegetation.

Impact Analysis Assumptions

The SDIP would result in temporary and permanent impacts on vegetation and wetland resources in the project area. Temporary impacts would be those that occur only during the construction period or during the maintenance dredging, which will be conducted once within 3–5 years after construction. Permanent impacts would be irreversible changes in land cover types.

In assessing the magnitude of possible impacts, the following project understandings and assumptions were made regarding construction, project operations, and maintenance activities.

- **Temporary impact areas** at each gate site caused by equipment staging and equipment movement would include the temporary staging area, any new temporary access roads, and the area within the temporary construction easement (shown as *Project Area* on Figures 6.2-2–6.2-5). However, as discussed under “Environmental Commitments” in Chapter 2, all staging areas and access roads will be selected to avoid sensitive biological resources. Temporary impacts would occur within any portions of the channels that would be dewatered for gate construction if the cofferdam method is used for gate construction. These impacts would occur only during construction. Temporary impacts associated with dredging would include the following categories:
    - Sealed clamshell dredging would be used at the gate sites and spot dredging locations for the siphon extensions. Clamshell dredging could also potentially be used at the West Canal, Middle River, and Old River dredge areas. The clamshell dredging method would occur either from barges or the levee top. Dredged material would be transported to a barge or to the landside of the levee in the bucket attached to the arm of the dredge equipment into a runoff management basin.
    - Temporary impacts of initial dredging, using a sealed clamshell to clear the area for construction and placement of the gate, at gate sites would affect the area 150 feet upstream and 350 feet downstream of each gate site. Maintenance dredging at the gate sites would occur within 150 feet

upstream of each gate. All riparian vegetation would be avoided in the upstream and downstream areas.

- Hydraulic dredging, if used, would occur from barges in West Canal, Middle River, and Old River. By this method, dredged material would be siphoned into a flexible pipe and transported to a stationary pipe that extended up the levee face and over the levee. Decant water would be returned to the river via another stationary pipe.
- If hydraulic dredging is used at the West Canal, Middle River, and Old River conveyance dredging areas (Figures 6.2-6–6.2-8), temporary impacts of initial dredging would include the locations where dredge disposal pipelines extend across the levee face. Therefore, this analysis assumes removal of vegetation at up to two crossings of the levee face for placing pipes on West Canal, up to 12 crossings on Middle River, and up to two crossings on Old River, for a total of 16 crossings. Old River dredged material would be barged to the Stewarts Tract dredged material disposal area. The analysis assumes that each pipe crossing would directly remove vegetation in a 10-foot-wide strip across the estimated 15-foot-high levee face. Vegetation removal would total approximately 150 square feet at each pipe location, for a total of up to 0.06 acre (2,400 square feet) over the 16 crossings.
- Temporary impacts of conveyance dredging at West Canal, Middle River, and Old River (Figure 6.2-1) may also include some pruning of riparian vegetation that overhangs the water surface and that may impede barge access. The number of trees that may require pruning is likely to be small and is not quantifiable based on the current level of design.
- The extent of dredge material disposal areas at the three conveyance dredging areas would include impacts on up to 155 acres for disposal areas on Roberts Island for the Middle River dredge area, and up to 10 acres for a disposal area on Stewarts Tract for Old River and Middle River dredging activities. Currently a total of 148.9 acres have been identified and mapped within the proposed dredged material disposal areas on Roberts Island and Stewarts Tract. Dredged material disposal for the West Canal dredge area will be at an existing pond on Fabian Tract and will not create additional impacts.
- Proposed locations of the dredge material disposal areas have been identified, and DWR has mapped land cover types within the disposal area footprints (Figure 2-8). DWR has committed to constructing all dredge drying areas on agricultural land adjacent to the dredge operations and to avoiding sensitive habitats, including wetlands and occurrences of special-status species. It is assumed that construction, operation, and removal of the dredged material disposal areas will not affect adjacent sensitive resources or land cover types, including (i.e., not limited to) wetlands and other waters of the United States, riparian, and VELB habitat. These disposal areas would remain in use for up to 5 years and would then be returned to agricultural use.

- Temporary construction staging for siphon extensions would occupy approximately 100 square feet of channel at each location (Figure 2-9). This analysis assumes that construction activities at each of the 24 locations would temporarily affect an area of up to 100 square feet, for a project-wide impact of approximately 0.06 acre (2,400 square feet) of perennial tidal aquatic habitat. Siphon extension activities and dredging around siphons would occur completely in the channel and would not affect adjacent land or levees. Construction and dredging methods could affect vegetation and wetland resources in the vicinity of the extensions, depending the construction method(s) to be used.

- **Permanent impact areas** for each gate site and dredge area would include:
  - all land and channel aquatic area within the footprint of the gate and associated structures (e.g., control structure, parking area);
  - new permanent access roads;
  - extent of levee where slope protection would be placed;
  - intertidal areas that experience changes in hydrologic regime during project operation, causing intertidal vegetation zones to shift location in response to the new tide levels;
  - dredge material disposal areas to be used for dredging at gate sites (sealed clamshell dredge spoils would require runoff management basins to dewater dredged material prior to transport to a dredged material disposal area [Figure 2-1]) (this analysis assumes that each disposal area at the gate sites would occupy up to 1.2 acres); and
  - up to 24 siphon extensions, which will lie below the ordinary high-tide level of channels. This analysis assumes that placement of a siphon extension at each of the 24 locations would permanently affect an area of up to 12 square feet, for a project-wide impact of approximately 0.01 acre (288 square feet) of perennial tidal aquatic habitat.

- Initial dredging would occur as part of project construction, and one additional maintenance conveyance dredging for maintenance purposes would occur within 3 to 5 years of the initial dredging. It is expected that this dredging would be necessary every 3 to 5 years for the life of the project and that dredging activities would be minimal, removing only sediments that are deposited on the upstream side of the gate. This analysis includes only the initial dredging at the time of construction and the first round of maintenance dredging. Any dredging at a later time would be reviewed in a separate document. It is assumed that maintenance dredging at the gates and the three dredge areas would affect only the channel bottom and would not affect intertidal vegetation, based on the Project Commitments for the Dredging and Sampling Analysis Plan described in Chapter 2.

- Erosion of levees and in-channel islands in the Delta is primarily caused by wind- and boat-generated waves and by the shear stress from the channel flow (California Department of Water Resources 2003c). Dredging, therefore, is not a major cause of erosion in the project area. Slopes of dredging would be gentle enough to prevent any effect on levees or in-channel islands, dredging would occur in the channel center, and details of dredging slopes would be addressed in the site-specific dredging plans (see additional discussion of sediment transport and scouring in Section 5.6).

- All in-channel islands would be avoided during sealed clamshell dredging from a barge. Patches of tule and cattail tidal emergent wetland would be avoided during placement of the stationary pipes for hydraulic dredging.
- For dredging at the gate sites, three conveyance dredging areas, and siphon extensions, no impacts are assumed where a 6- to 12-inch layer of dredged material would be placed on unvegetated areas on the landside of the levees for levee reinforcement.
- Before construction begins, DWR would obtain all necessary permits pertaining to affected waters of the United States. Grading or other construction activities within all habitats on the waterside of levees would require a Streambed Alteration Agreement from DFG. Discharge of dredged or fill material into waters of the United States, including that associated with gate construction and placement of siphon extensions, would require a CWA Section 404 permit from the Corps and Section 401 certification from the RWQCB. Grading would require a CWA Section 402 permit and preparation of a SWPPP. Because the project area includes navigable waterways, work within the channels is also subject to Corps jurisdiction under the Rivers and Harbors Act of 1899. The permitting process would also require compensation for construction, initial dredging, and maintenance dredging impacts.
- The analysis for the Operational Components of Alternatives 2A–2D assumes that water levels will be maintained to at least 0.0 foot msl throughout the study area. For Alternatives 3B and 4B, water levels are likely to drop below the 0.0 foot msl level during periods of increased pumping in the areas that will not be protected by the construction of flow control gates.
- During gate operation, changes in water level of more than 1 foot would result in a measurable gain or loss of perennial tidal aquatic habitat and inundation or stranding of emergent wetland vegetation. Water level changes of less than 1 foot could have measurable effects on intertidal special-status plants if the change results in the loss of suitable habitat.
- The cross-sectional shapes of study area channels have not bee mapped. During periods of increased pumping without the protection of water levels by flow control gates under Alternatives 3B and 4B, subsurface projections on the channel bottom may become exposed and create patches of wetland in the channel. However, due to the lack of information on channel topography, the potential for creation of new wetland area cannot be predicted or quantified. Therefore, this potential for mitigation of some wetland loss is not included in the impact analysis.
- The estimated loss of waters of the United States under Alternatives 3B and 4B was base on an assumed decrease in the minimum water level of 2 feet during the periods of increased pumping from April to October. The

minimum water levels would remain the same as under current conditions with temporary barriers from October to March.

- Losses of common or artificial vegetation community types, including agriculture, ruderal, and landscaping, would be considered less-than-significant impacts on vegetation.

Impact Assessment Approach and Methods

This vegetation and wetland resources impact analysis is based on:

- the most current proposed project, as developed by DWR and summarized in the above assumptions;
- existing biological resource information (sources are discussed in "Affected Environment"); and
- current baseline conditions (as of 2000–2001, 2003, and 2004 field surveys).

The mitigation measures for impacts on vegetation and wetland resources were developed through review of the MSCS (CALFED Bay-Delta Program 2000e), prior environmental impact studies and reports for affected resources, discussions with resource agency personnel, and professional judgment.

Impacts in the following sections are grouped into:

- structural/physical components, which include impacts resulting from construction of the gates and dredging at the gate sites, three conveyance dredging areas, and siphon extension locations, and
- operational components, which include impacts resulting from operation of gates (i.e., changes in water level/tidal regime).

Most construction-related impacts address all project components, but, for clarity, some construction-related impacts are divided into gate construction, dredging at gates, dredging at the three conveyance dredging areas, and spot dredging at siphon extensions.

Land Cover Types

Construction impacts on land cover types were assessed by comparing the project footprint within the gate sites and the dredge areas with the mapped land cover types. Loss of all vegetation is assumed within the construction footprint. No loss of vegetation is assumed on in-channel islands within the dredge areas because the dredge equipment would not directly encroach on the islands, and no significant increase in scouring would result from dredging (Section 5.6). Hydrologic modeling was used to identify the location and magnitude of water level changes expected to result from operation of the project.

Special-Status Plants

For plant species known to occur in the project area and included in the ASIP (i.e., rose-mallow, Delta tule pea, and Mason's lilaeopsis), a species assessment model was used to analyze the impacts and determine appropriate mitigation. The results from the species assessment model are summarized in the following impacts section, and the complete model analysis is included in the ASIP (SDIP ASIP).

The species assessment model illustrates the potential linkages between project actions, environmental conditions, environmental correlates (the environmental conditions that determine biological performance), and biological performance (survival of the species) (Figure 6.2-11). Assessment of project impacts using the species assessment model considers the occurrence of each life stage of the species (i.e., plant establishment, plant growth and maintenance, and dispersal) relative to environmental conditions that result from the magnitude and timing of project activities. Elements of the model include life stage occurrence, descriptions of changes in environmental conditions, key environmental correlates, and measures of the species' biological performance.

The environmental correlates affecting dispersal of intertidal plants include continuity of habitat and entrainment. Environmental correlates will be affected by environmental conditions that may be altered by the project, including placement and operation of the permanent gates, proposed water diversions, and flow velocity, water level, and pattern in the channels during gate operation.

Establishment, growth, and maintenance of intertidal plants are affected by a number of environmental correlates, including contaminants, key habitat quantity, scour, physical injury, and competition. The environmental conditions affecting this set of correlates include tidal level, substrate, water salinity, nonnative competitors, gate construction, and flow velocity.

The assessment of the species response using the model is based on professional judgment and qualitative interpretation of available data. For each environmental correlate, hypotheses state relationships between environmental conditions and the expected species response, including explanations of the underlying principles of certain observed or expected species responses. Other key components of the model are described below:

- *Species sensitivity* to changes in environmental conditions documents the judgment applied in assessing the effects of SDIP actions.
- C*ertainty* of the level of sensitivity is considered for each environmental correlate. Certainty indicates the potential that the species' predicted response is reliable, adequate, accurate, and precise. Certainty comprises proof and error.
- *Proof* is the scientific support for the hypotheses, ranging from speculative relationships (i.e., low certainty) to those relationships that are thoroughly

established, generally accepted, and supported by peer-reviewed evidence (i.e., high certainty).

Certainty provides the basis for assessing the risk associated with management decisions, based on the estimated project effects, including risk to the persistence and resilience of the species population. Development of effective mitigation for project effects, including avoidance, minimization, and compensation measures, also depends on certainty.

Waters of the United States

Impacts on waters of the United States were analyzed using the same approach as for the land cover types described above. The land cover types included in this category are tidal perennial aquatic, tidal freshwater emergent, cottonwood-willow woodland wetland, and willow scrub wetland.

Significance Criteria

The criteria for determining significant impacts on biological resources were developed by reviewing State CEQA Guidelines and the CALFED Programmatic EIS/EIR (CALFED Bay-Delta Program 2000b). Based on these sources of information, the SDIP would likely cause a significant impact if it would result in:

- temporary or permanent removal, filling, grading, or disturbance of waters of the United States, including wetlands and jurisdictional and nonjurisdictional woody riparian vegetation;
- temporary or permanent loss of occupied special-status species habitat or indirect or direct mortality of more than 10% of the individuals of a special-status species documented by project surveys in the project area;
- a reduction in the area or geographic range of rare natural communities and significant natural areas;
- a conflict with the provisions of the MSCS (CALFED Bay-Delta Program 2000e); or
- spread or introduce new noxious weed species into the project area.

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project-specific actions. The mitigation measures address the short-term, long-term, and cumulative effects of CALFED.

The discussion of significant impacts and mitigation measures in this section will include a citation of one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the SDIP. These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to the SDIP resource area are listed below; therefore, numbering may appear out of sequence. A complete list of CALFED programmatic mitigation measures is provided in Appendix E, "Mitigation Measures Adopted in the CALFED Record of Decision."

1. Avoid direct or indirect disturbance to wetland and riparian communities, special-status species habitat, rare natural communities, significant natural areas, and other sensitive habitat.
2. Restore and enhance sufficient in-kind wetland and riparian habitat or rare natural communities and significant natural areas at offsite locations (near project area) before or at the time that project impacts are incurred. Replace not only acreage lost, but also habitat value loss.
3. Design program features to permit on-site mitigation or nearby restoration of wetland, riparian habitat, special-status species habitat, rare natural communities, and significant natural areas that have been removed by permanent facilities.
4. Phase the implementation of Ecosystem Restoration Program (ERP) habitat restoration to offset temporary habitat losses and to restore habitat (including special-status species habitat) before, or at the same time that, project impacts associated with the ERP are incurred.
5. Restore wetland and riparian communities, special-status species habitat, and wildlife use areas temporarily disturbed by on-site construction activities immediately following construction. Example actions include direct planting of native plants, controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow for the natural reestablishment of the affected plant community.
6. Avoid creating wetlands in areas with high concentrations of mercury in sediments and anaerobic conditions.
14. Avoid direct or indirect disturbance to areas occupied by special-status species.
17. Restore and enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been affected by the permanent removal of occupied habitat areas.
19. For species for which relocation or artificial propagation is feasible, establish additional populations of special-status species adversely affected by the Program in suitable habitat areas elsewhere within their historical range.

Alternative 1 (No Action)

Under the No Action alternative, the SDIP would not be implemented, the permanent fish control and flow control gates would not be built or operated, and an increase in diversion and pumping would not occur. The State Water Project would also continue to operate under its currently permitted pumping capacity of 6,680 cfs. All of the existing temporary barriers (head of Old River fish control barrier, and Middle River, Grant Line Canal, and Old River at DMC barriers) would continue to be installed and removed annually. No dredging would occur under Alternative 1.

Under Alternative 1, impacts on vegetation as a result of annually installing the temporary barriers would continue. The existing conditions at the barrier sites are such that installing and removing the barriers is not anticipated to result in alteration of existing riparian communities nor adversely affect special-status plants. However, activities involved with placing and removing fill within perennial aquatic habitat would continue to have a significant impact on water quality and habitat. Placement of the temporary rock barriers causes a temporary loss of aquatic habitat, releases sediments into the water, and blocks movement of plant propagules when the temporary barriers are in place. Mitigation for the original loss of habitat attributable to barrier installation and monitoring of water quality in the barrier areas was implemented as part of the environmental compliance requirements for the project.

2020 Conditions

Under Future No Action conditions (2020 conditions), SDIP would not be implemented. It is expected that the temporary barriers program would continue. Activities involved with placing and removing fill in perennial aquatic habitat would continue to have a significant impact on water quality and habitat, which has been mitigated as part of the original project. It is expected that the effects caused by placement of the temporary barriers would remain the same as existing conditions.

No additional significant effects of Alternative 1 are anticipated. No mitigation is required.

Alternative 2A

Stage 1 (Physical/Structural Component)

Land Cover Types

Impacts on land cover types that are considered waters of the United States, including tidal perennial aquatic, tule and cattail tidal emergent wetland, and jurisdictional riparian land cover types, are discussed below in “Waters of the United States.” Impacts on other vegetated land cover types are discussed in this section. Land cover impact acreages for Alternatives 2A–2C are shown in Table 6.2-4.

Impact VEG-1: Loss or Alteration of Nonjurisdictional Woody Riparian Communities as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Gate Construction. Construction of the flow control gate at Old River at DMC would result in the permanent loss of less than 0.01 acre of nonjurisdictional willow scrub (Table 6.2-4). Construction of the Middle River and Grant Line Canal gates would not affect nonjurisdictional riparian vegetation. Loss of jurisdictional woody riparian communities at the gates is discussed under Impact VEG- 8. No riparian vegetation occurs at the head of Old River fish control gate site.

Sealed clamshell dredging at the three flow control gate sites would avoid impacts on riparian vegetation. Dredging at the head of Old River fish control gate would not affect any riparian vegetation.

Gate Operation. Nonjurisdictional riparian habitats occupy the area above the existing high-tide levels. Gate operation would not substantially alter the existing high-tide levels from existing conditions in the areas upstream or downstream of the gates. The low-tide level would decrease by approximately 1 foot upstream of the gates and by approximately 2–3 inches in the downstream area, as further discussed under Impact VEG-5. Woody riparian vegetation generally has root systems that can access groundwater when surface water is unavailable. The change in water availability caused by decreased low-tide levels downstream of the gates under project operations would not cause a perceptible change in water availability to riparian vegetation. Because the high tide during project operations would not substantially change from existing conditions and low-tide changes would not be expected to significantly affect riparian vegetation, gate operation is not expected to have a significant impact on the nonjurisdictional riparian vegetation. This alteration would be considered a less-than-significant impact. No mitigation is required.

Channel Dredging. The use of hydraulic dredging in West Canal, Middle River, and Old River would minimize but not entirely avoid temporary impacts on woody riparian vegetation because of the placement of the stationary pipes for dredged material on the levee face. Pockets of riparian vegetation occur on the levees between Middle River and Union and Roberts Islands. The exact locations of stationary pipes to transport dredged material over the levees to dredge disposal areas are currently unknown, but placement of pipes on the levee banks would temporarily affect up to a maximum of 16 locations of woody riparian vegetation throughout the three conveyance dredging areas. Assuming removal of vegetation in a 10-foot-wide band for placement of each of the 16 stationary pipes and an estimated levee face height of 15 feet, up to 0.06 acre (2,400 square feet) of woody riparian vegetation would be removed. DWR would avoid placing pipe within woody riparian vegetation to the extent possible. This impact conservatively assumes the maximum possible impact, and the actual impact would likely be less. This impact would continue for up to 5 years after initial dredging, until the pipes were removed and the banks were revegetated. This impact is considered significant.

Table 6.2-4. Land Cover Impacts Associated with Gate Construction and Dredging—Alternatives 2A–2C

	Acreages Affected by Gate Construction					Acreages Affected by Dredging[1]							
Land Cover Type	Middle River Flow Control Gate	Grant Line Canal Flow Control Gate	Old River at DMC Flow Control Gate	Head of Old River Fish Gate	Total Permanent Impacts Associated with Gate Construction	Impacts Associated with Dredging at Gate Sites	West Canal Conveyance Dredging Area	Middle River Conveyance Dredging Area	Old River Conveyance Dredging Area	Total Temporary Impacts Associated with Conveyance Dredging	Temporary Impacts Associated with Agricultural Diversions	Permanent Impacts Associated with Agricultural Diversions	Impacts Associated with Dredge Material Disposal[4]
Tidal perennial aquatic	0.16	0.32	0.26	0.14	0.88	29.82	73.02	72.67	123.46	269.15	0.06	<0.01	0
Tule and cattail tidal emergent wetland	0.07	<0.01	<0.01	0	<0.08	0	0	0	0	0	0	0	0
Cottonwood-willow woodland	0	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Cottonwood-willow woodland wetland	0	0.03	0	0	0.03	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Valley oak riparian woodland	0	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub	0	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub wetland	0.02	0.03	0.12	0	0.17	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Willow scrub	0	0	<0.01	0	<0.01	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Willow scrub wetland	0	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Agricultural land	0.50	0.25	2.00	0	2.75	4.80[3]	0	0	0	0	0	0	101.50
Ruderal	0	0.02	0	0.02	0.04	0	0	0	0	0	0	0	47.40

Notes:

DMC = Delta-Mendota Canal.

[1] Dredge impacts assumed impacts on all tidal perennial aquatic habitat within the dredge area. Actual loss of tidal perennial aquatic habitat will probably be less as a result of confining dredge activities to the center of the channel.

[2] Dredge impacts on individual riparian land cover types are not yet determined because the exact placement of the stationary pipes has not been identified. The riparian impact will total up to 0.06 acre at the three dredge areas.

[3] The acreage for the gate site agricultural impact includes the areas used for dredge drying areas at all four gate sites, which was assumed to require 1.2 acres at each site. This represents a permanent impact.

[4] The acreage for dredge drying areas at the 3 conveyance dredging areas is a temporary impact.

Sealed clamshell dredging of channels, if used in the conveyance dredging areas, would avoid direct impacts on all riparian vegetation. Clamshell dredging at siphon locations would not have an impact on woody riparian vegetation.

Temporary indirect impacts of dredging adjacent to the gate sites, at all three conveyance dredging locations, and at siphon extensions could include decreased water quality levels caused by turbidity. Riparian vegetation near the waterline would not likely be significantly affected by the temporarily small increase in water turbidity. See Impact WQ-2 for discussion of water quality impacts during dredging.

Riparian areas are suitable habitat for special-status plants, are important wildlife habitat for breeding and foraging, and provide movement corridors and links between habitats. DFG considers riparian habitat a sensitive natural community because of its high value to wildlife and its documented scarcity in California.

The temporary impacts on up to 0.06 acre of woody riparian vegetation as a result of conveyance dredging would be considered significant. These losses of woody riparian vegetation would reduce the extent of riparian communities, which are rare natural communities. Implementation of the mitigation measures listed below and environmental commitments (Chapter 2) would reduce this impact to a less-than-significant level.

Mitigation Measure VEG-MM-1: Minimize Impacts on Sensitive Biological Resources. DWR and Reclamation will include the following measures in the project construction conditions to minimize indirect impacts on sensitive natural communities, including riparian habitats and waters of the United States, and on special-status plants:

1. DWR and Reclamation will provide a biologist/environmental monitor who will be responsible for monitoring implementation of the conditions in the state and federal permits (CWA Section 401, 402, and 404; ESA Section 7; Fish and Game Code Section 1602; project plans (SWPPP); and EIS/EIR mitigation measures).
2. The biologist/environmental monitor will determine the location of environmentally sensitive areas adjacent to each gate site and dredge area based on mapping of existing land cover types and special-status plant species (Figures 6.2-2–6.2-9). To avoid construction-phase disturbance to sensitive habitats immediately adjacent to the project area, the monitor will identify the boundaries of sensitive habitats and add a 50-foot buffer, where feasible, using orange construction barrier fencing. The fencing will be mapped on the project designs. Erosion-control fencing will also be placed at the edges of construction where the construction activities are upslope of wetlands and channels to prevent washing of sediments offsite. The ESA and erosion-control fencing will be installed before any construction activities begin and will be maintained throughout the construction period.
3. The biologist/environmental monitor will ensure the avoidance of all sensitive habitat areas, including patches of tule and cattail emergent wetland in channels, during dredging operations.

4. The biologist/environmental monitor will flag the locations of special-status plants recorded during the 2000–2001 and preconstruction surveys (outlined in VEG-MM-4) that are in proposed construction and dredging areas but outside of the gate footprints. The monitor will ensure that floating vegetation is not washed onto these special-status plants on the shoreline during in-channel construction and dredging activities.
5. DWR and Reclamation will provide a worker environmental training program for all construction personnel prior to the start of construction activities. The program will educate workers about special-status species, riparian habitats, and waters of the United States present on and adjacent to the site and also about the regulations and penalties for unmitigated impacts on these sensitive biological resources.
6. Landing on in-channel islands, anchoring boats and/or barges to these islands, and encroaching by construction personnel on the islands will be prohibited. The exception to this measure is at Grant Line Canal, where the utility lines will cross the island, and construction personnel will have to access the utility corridor during installation.
7. Where feasible, construction will avoid removal of woody vegetation by trimming vegetation to approximately 1 foot above ground level
8. Following construction at the gate sites, the construction contractor will remove all trash and construction debris and implement a revegetation plan for temporarily disturbed vegetation in the construction zones. The elements that should be included in the revegetation of these sites are described in Mitigation Measures VEG-MM-2 and VEG-MM-7.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1 and 14.

Mitigation Measure VEG-MM-2: Compensate for Unavoidable Temporary and Permanent Loss of Riparian Habitats. DWR and Reclamation will compensate for the temporary loss of up to 0.06 acre of nonjurisdictional riparian habitat for dredge pipe placement in conveyance dredging areas permanent loss of less than 0.01 acre of nonjurisdictional willow scrub at the Old River at DMC gate, and permanent loss of up to 0.20 acre of jurisdictional riparian vegetation at the Middle River, Grant Line Canal, and Old River at DMC gates. Compensation will include restoring or enhancing in-kind riparian habitat at a ratio of 2–3 acres for each acre affected, for a total of 0.54 – 0.81 acre. If temporary impacts are avoided during placement of stationary pipelines, the required mitigation will be less. The mitigation ratio will ensure long-term replacement of habitat functions and values. Revegetation will be planned and implemented prior to the removal of existing riparian vegetation. This mitigation is consistent with the MSCS Conservation Measure to “restore or enhance 2 to 5 acres of additional in-kind habitat for every acre of affected habitat near where impacts are incurred before implementing actions that could result in the loss or degradation of habitat” (CALFED Bay-Delta Program 2000e).

As much of the mitigation habitat as possible will be created on-site or near the project area. The Grant Line Canal gate impact will be mitigated by replanting the disturbed vegetation on the in-channel island. This mitigation is consistent with the following MSCS Conservation Measure (CALFED Bay-Delta Program 2000e):

> to the extent practicable, include project design features that allow for onsite reestablishment and long-term maintenance of riparian vegetation following project construction.

Site selection, however, will avoid areas where future dredging, improvements, or maintenance is likely. DWR and Reclamation will obtain site access through a conservation easement or fee title. To the extent practicable, mitigation sites will be located near ongoing and future ERP projects.

In addition to the requirements of the MSCS Conservation Measures, DWR and Reclamation will prepare a revegetation plan and monitor the restoration or enhancement mitigation sites. The revegetation plan will be prepared by a qualified restoration ecologist and reviewed by the appropriate agencies. The revegetation plan will specify the planting stock appropriate for each riparian land cover type and each mitigation site, ensuring the use of genetic stock from the south Delta area. The plan will employ the most successful techniques available at the time of planting. Success criteria will be established as part of the plan. Plantings will be maintained for a minimum of 5 years, including weed removal, irrigation, and herbivory protection.

DWR and Reclamation will monitor the plantings annually for 4 years, followed by monitoring in years 8 and 10 following initial mitigation implementation, to ensure they have established successfully. DWR and Reclamation will submit annual monitoring reports of survival to the regulatory agencies issuing permits related to habitat impacts, including the DFG, Corps, and USFWS. Replanting will be necessary if success criteria are not being met. The riparian habitat mitigation will be considered successful when the number of sapling trees established meet the success criteria, the habitat no longer requires active management, and vegetation is arranged in groups that, when mature, replicate the area, natural structure, and species composition of similar riparian habitats in the region.

Specific mitigation funding sources are not identified at this time, but funding will be required and could include contributions from Proposition 13 (Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Act, 2000), Proposition 204 (SB 900) (Safe, Clean, Reliable Water Supply Act, 1996), and/or water contractor contributions.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, and 5.

Impact VEG-2: Loss of Agricultural Land and Ruderal Vegetation as a Result of Gate Construction and Disposal of Dredged Material.

Agricultural land and ruderal vegetation will be permanently lost as a result of gate construction and dredging at gate sites and the three conveyance dredging areas. These two components are discussed below.

Gate Construction and Channel Dredging. Construction at the four gate sites would result in the removal of 7.55 acres of agricultural land and 0.04 acre of ruderal vegetation. Approximately 1.2 acres of agricultural land at each gate site, for a total of 4.8 acres, would be permanently lost as a result of construction of runoff management basins at each gate site.

Conveyance Dredging. Up to 165 acres of temporary spoils ponds or runoff management basins will be constructed as part of the conveyance dredging action. The potential locations of the spoils ponds or runoff management basins have been identified and mapped, although specific sites have not been selected. It is assumed, however, that all spoils ponds or runoff management basin areas would be constructed on agricultural land adjacent to the dredge operations. DWR is committed to minimizing impacts on sensitive habitats, including wetlands and occurrences of special-status species, and will construct the ponds or basins on agricultural land. These factors will play a major role in the determination of the dredged material disposal sites. These dredge ponds or basins would remain in use for up to 7 years and would then be returned to agricultural use.

Siphon Extensions. Dredged material associated with siphon extensions would be placed in the disposal sites described above.

Because agricultural land and ruderal communities support few native plant species, have low potential for supporting special-status plant species, and are locally and regionally abundant throughout the Delta, the impact on vegetation would be less than significant, and no mitigation is required.

Impact VEG-3: Removal of Giant Reed for Gate Construction.

Approximately 0.08 acre of giant reed is present on the north bank adjacent to the Old River at DMC gate project area. Assuming removal of all vegetation within the project area, this area of giant reed (shown as *Arundo* on Figure 6.2-5) would also be removed. Giant reed is recognized by the California Exotic Pest Plant Council and the California Department of Food and Agriculture (California Exotic Pest Plant Council 1999; California Department of Food and Agriculture 2000) as a noxious invasive weed that displaces and degrades the wildlife habitat value of riparian vegetation.

Removal of the stand of giant reed during construction of the Old River at DMC gate would be a beneficial impact. No mitigation is required.

Impact VEG-4: Spread of Noxious Weeds as a Result of Gate Construction and Channel Dredging.

Gate construction and channel dredging activities 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 are not currently found in the project area, including exotic pest plant species. Construction activities could also spread exotic pest plants that already occur in the project area. One noxious weed, giant reed, has been documented in the project area.

Introduction or spread of noxious weeds in the project area would be considered a significant impact because it would result in degradation of special-status plant habitat and riparian communities. Implementation of Mitigation Measure VEG-MM-3 below would reduce this impact to a less-than-significant level.

Mitigation Measure VEG-MM-3: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging. DWR and Reclamation will include the following measures in the project construction conditions to minimize the potential for the introduction of new noxious weeds and the spread of weeds previously documented in the project area:

1. Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of noxious weed infestations.
2. Treat isolated infestations of giant reed or other noxious weeds identified in the project area with approved eradication methods at an appropriate time to prevent further formation of seed and destroy viable plant parts and seed.
3. Minimize surface disturbance to the greatest extent possible.
4. Seed all disturbed areas with certified weed-free native and nonnative mixes, as provided in the revegetation plan developed in cooperation with DFG. Mulch with certified weed-free mulch. Rice straw may be used to mulch upland areas.
5. Use native, noninvasive species or nonpersistent hybrids in erosion control plantings to stabilize site conditions and prevent invasive species from colonizing.
6. Restore or enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been adversely affected by the permanent removal of occupied habitat areas.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measure 5.

Special-Status Plants

Impact VEG-5: Loss or Disturbance of Mason's Lilaeopsis Stands or Potential Habitat as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Approximately 175 stands of Mason's lilaeopsis were identified in the study area during the 2000–2001 surveys (Figure 6.2-10). Mason's lilaeopsis stands located near the project area include:

- approximately 20 stands almost 0.5 mile downstream of the Middle River gate site;
- approximately 20 stands within the project area along Grant Line Canal, up to three of these within the gate site and nine within 0.5 mile upstream of the site;
- one stand less than 0.25 mile upstream of the Old River at DMC gate site and another approximately four stands immediately downstream of the site;
- approximately 17 stands along the West Canal within the proposed conveyance dredging area;
- approximately six stands at siphon extension locations on Victoria and North Canals; and
- approximately four stands at the siphon extension at the confluence of Old River and Grant Line Canal and Fabian and Bell Canal.

Gate Construction. Construction activities associated with the Middle River gate are not anticipated to affect the lilaeopsis stands located downstream. There would be no direct construction impact on these stands. Indirect impacts caused by the spread or introduction of invasive plants or chemical contaminants are unlikely to affect plants nearly 0.5 mile downstream.

Construction of the Grant Line Canal gate would have a direct impact on Mason's lilaeopsis, resulting in the permanent loss of up to three stands of the lilaeopsis as a result of excavation for the cofferdam, if used, and the placement of riprap for slope protection of the levee. Construction would remove the existing stands, permanently remove the habitat for any reestablishment after construction, and reduce the number of reproductive plants in the area. This impact would be significant.

Indirect impacts could result from construction activities for the Grant Line Canal and Old River at DMC gates. Upstream of the Grant Line Canal gate footprint, up to nine other stands could be indirectly affected. Construction of the Old River at DMC gate could indirectly affect the approximately five stands upstream and downstream of the gate. Construction equipment could spread or introduce plants that compete with Mason's lilaeopsis for mudflat habitat, including pampas grass and water hyacinth. This impact would be significant. The equipment could also cause water contamination by leaking oil or fuel, which has the potential to be toxic to the established stands of lilaeopsis. However, the potential for water contamination by construction equipment is unlikely to exceed the existing potential for contamination from recreational boats.

Gate Operation. Changes in tidal water levels in the project area would occur because of gate operations. The flow control gates would operate through most of the growing season. The head of Old River fish control gate would not operate during the summer.

Upstream of the gates during gate operation, high-tide water levels would remain approximately the same as existing conditions, except at the Grant Line Canal gate, where the high-tide level would decrease by up to 1 foot. Low-tide levels would decrease by up to 1 foot from existing conditions with the temporary barriers during the summer months (Section 5.2; Figures 5.2-33, 5.2-37, 5.2-39, and 5.2-41; Impacts HY-3, HY-5, HY-6, and HY-7). The net effect of the project would be an increase in the extent of the intertidal zone by up to 1 foot in the area upstream of each gate (i.e., on Middle River from the gate to Old River; on Grant Line Canal to Old River; and on Old River to the head of Old River). This increase would reverse much of the effect on low-tide levels during spring and summer caused by the temporary barriers program. Downstream of the gates during the growing season, water levels would be 2–3 inches lower than existing conditions at low tide and high tide. The net result would be a shifting of the water level downslope in the area downstream of the gate, but there would be no substantial change in the extent of intertidal habitat.

The high-tide level upstream of Grant Line Canal would be reduced by project operations to a minimum of about 2 feet and would be higher at most times (Figure 5.2-41). Mason's lilaeopsis grows at elevations up to about 2 feet msl (California Department of Water Resources 1999c, 2001b). The decrease in high-tide level upstream of the gate, therefore, would not likely affect the tidal inundation of existing Mason's lilaeopsis stands. The decrease in low-tide levels upstream of all gates would potentially increase the extent of suitable intertidal habitat for Mason's lilaeopsis. The approximately 17 stands of Mason's lilaeopsis upstream of the Grant Line Canal gate and 1 stand upstream of the Old River at DMC gate would not likely be significantly affected by gate operations.

The Mason's lilaeopsis stands located downstream of the three gate sites could experience a shifting of low- and high-tide water levels downslope by 2–3 inches (Section 5.2; Figures 5.2-29 and 5.2-31; Impacts HY-1 and HY-2). Stands of Mason's lilaeopsis closest to CCF occur in areas that would experience the greatest decreases in the tidal water level. The low-tide level would decrease by less than 1 foot, and the high-tide level would decrease by 3 feet but would remain above 2 feet msl (Figure 5.2-31). The lilaeopsis could grow farther downslope to occupy the new intertidal area created by the increased pumping diversions. The decrease in low-tide levels downstream of all gates and in the area near CCF would potentially increase the extent of suitable intertidal habitat for Mason's lilaeopsis. The stands of Mason's lilaeopsis downstream of gates, therefore, would not be significantly affected by project operations.

No significant increase in tidal flow velocity would occur in the project area as a result of the gate operation, and flow velocities would be reduced by the increased conveyance capacity produced by dredging (see Impacts HY-3 through HY-7 in Section 5.2 for additional discussion of changes in tidal flow). This effect would be a less-than-significant impact on Mason's lilaeopsis.

No discernable change in average salinity would be anticipated as a result of gate operations (Section 5.3). The long-term average salinity would be 600–700 µS/cm, which is equivalent to less than 1 ppt (Figures 5.3-15–5.3-17). The salinity objective for project operations is 1,000 µS/cm. Growth of Mason's lilaeopsis is not affected by less than 3 ppt salinity (Fiedler and Zebell 1993). Seed germination is best at 0 ppt salinity, but existing conditions exceed that level. The extent of suitable habitat for Mason's lilaeopsis, therefore, would not be altered as a result of changes in salinity. This effect would be a less-than-significant impact.

Operation of the permanent gates would not be anticipated to affect dispersal of Mason's lilaeopsis upstream or downstream of the gates. The lilaeopsis colonizes new habitat either by seed or vegetative mats of plants that float to new habitat (Golden and Fiedler 1991). Either method requires transportation by water. The permanent gates could block movement upstream and downstream for a substantial portion of the day during the operation periods in spring, summer, and fall. The lilaeopsis propagules (seed or mat), however, would be able to move across the gates during the portion of the day when the gates were open. Implementation of permanent gates, therefore, would not be expected to change the success of colonization of new habitat by Mason's lilaeopsis.

The operation of the permanent gates would not substantially change the upstream or downstream flow velocity, salinity, or dispersal potential from the existing conditions in the project area. Changes in the upstream and downstream tidal water levels from project operation could result in increased suitable habitat for Mason's lilaeopsis and would not have an adverse effect on Mason's lilaeopsis. Although this effect would be considered a less-than-significant impact, Mitigation Measure VEG-MM-6 is included below to monitor existing populations during the initial years of gate operation to verify the absence of impact.

Channel Dredging. Conveyance dredging of the West Canal and dredging at siphon extensions in Victoria, North, Grant Line, and Fabian and Bell Canals would avoid direct removal of Mason's lilaeopsis but could indirectly affect up to 27 stands that grow at the edges of the canals in these areas. Disturbance of the water in the canal from the barge during dredging could result in higher than normal wave action on the shoreline, which could dislodge lilaeopsis plants growing there or possibly wash floating vegetation on top of the plants, which would smother them. This impact would be significant. Dredge equipment also has the potential to contaminate the water with oil or fuel, which may be toxic to the lilaeopsis, but is unlikely to exceed the existing potential for water contamination produced by boats.

The decrease in water velocity after channel dredging may benefit Mason's lilaeopsis and other intertidal plants by reducing erosion of the canal banks. Transport of sediment (scouring) during channel dredging would be minimized to a less-than-significant level by implementing proposed dredging methods (Impact SS-4).

Mason's lilaeopsis is a state-listed rare species restricted to small areas of ephemeral habitat and susceptible to adverse effects by direct and indirect habitat loss. The project would result in the loss of up to three stands of Mason's lilaeopsis because of the direct impacts of project construction at the Grant Line Canal site. Disturbance of up to 41 stands would occur because of potential indirect impacts at the Grant Line Canal and Old River sites and indirect impacts of dredging activities in the West, Victoria, North, Grant Line, and Fabian and Bell Canals. Including disturbances that could eradicate the stands, the project could, therefore, cause mortality of more than 10% of the approximately 175 stands mapped in the project area. For this reason, the direct and indirect impacts of construction and dredging would be considered significant impacts. Implementation of Mitigation Measures VEG-MM-1 and those listed below would reduce these impacts to a less-than-significant level.

Mitigation Measure VEG-MM-4: Conduct Preconstruction Surveys for Special-Status Plants. Within 1 year prior to initiating gate construction or channel dredging, DWR and Reclamation will conduct special-status plant surveys of all proposed areas of disturbance. The purpose of these surveys will be to verify that the locations of special-status plants in the 2000–2001 surveys are extant, identify any new special-status plant occurrences, and cover any portions of the project area not previously identified. This mitigation is consistent with the MSCS Conservation Measure stating that (CALFED Bay-Delta Program 2000e):

> before implementing actions that could result in take or the loss or degradation of occupied habitat, conduct surveys in suitable habitat within portions of the species' range that CALFED actions could affect to determine the presence and distribution of the species.

The extent of mitigation for direct loss of or indirect impacts on special-status plants will be based on these survey results. Locations of special-status plants within proposed construction areas will be recorded using a GPS unit and flagged.

The survey will include mapping of tidal mud flat habitat in the project area, including the gate footprints and dredging areas. The survey will also include an evaluation of the habitat quality based on surrounding habitats (e.g., adjacent riprapped levee banks would lower the habitat quality, adjacent riparian vegetation would increase habitat quality). The extent of both Mason's lilaeopsis occupied habitat and unoccupied tidal mud flat habitat will be quantified for use in determining the amount of habitat mitigation required under Mitigation Measure VEG-MM-5.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measure 14.

Mitigation Measure VEG-MM-5: Minimize Impacts on and Compensate for Loss of Mason's Lilaeopsis. Stands of Mason's lilaeopsis that can be avoided within the construction area will be fenced, including a buffer of 50 feet on all sides.

DWR and Reclamation will initiate mitigation for unavoidable loss of Mason's lilaeopsis prior to construction and will base the compensation on the survey results obtained from the preconstruction surveys. The MSCS conservation measure for Mason's lilaeopsis habitat compensation states that "for each linear foot of occupied habitat lost, create 5 to 10 linear feet, depending on habitat quality, of suitable habitat with 1 year of loss" (CALFED Bay-Delta Program 2000e). Compensation for loss of Mason's lilaeopsis as a result of gate construction for the SDIP, therefore, will include creation of new tidal mud flat habitat at a ratio of 5–10 linear feet for each linear foot removed by the project. The quality of the removed occupied habitat will be evaluated during the preconstruction survey required under Mitigation Measure VEG-MM-4. Low-quality mud flat habitat at the base of riprapped levee banks, for example, would be mitigated at a ratio of 5:1 (5 linear feet created for each linear foot removed), while high-quality mud flat habitat adjacent to emergent wetland and/or riparian vegetation would be mitigated at or near the 10:1 (10 linear feet created for each linear foot removed) mitigation ratio. DWR will identify suitable habitat creation sites that:

- are located as close to the site of plant removal as possible;
- will include areas with minimal boat wakes, shallow water, and slow water velocities, and
- are not likely to be dredged or have other improvements constructed.

Created habitat will include a suitable mud flat substrate at appropriate elevations (approximately 0.5–2 feet NGVD) with minimal disturbance from boat wakes, channel dredging, and levee maintenance. DWR and Reclamation will obtain mitigation site access through a conservation easement or fee title. To the extent practicable, mitigation sites will be located near ongoing or future ERP projects.

If offsite mitigation sites are identified, mitigation will be implemented prior to the loss of occupied habitat, and salvaged plant material will be planted at the mitigation site. If onsite mitigation sites will be used, salvaged plant material will be stockpiled or propagated at a native plant nursery for later planting, and mitigation will be implemented as soon as practicable after completion of construction or dredging activities.

If offsite mitigation is necessary, a location that does not currently support tidal flats should be selected. An area that currently supports minimal habitat value, such as the portion of Old River upstream of the proposed fish control gate, would be desirable. If water is too deep at a potential mitigation site, dredged material could be used to construct a bench area as substrate for the tidal mud flat habitat. Prior to use, however, such material would be subject to analysis for the presence of contaminants, such as heavy metals. Excessively high levels of contaminants may prohibit the use of dredged materials for bench construction. This mitigation approach is also likely to require permitting under Sections 401 and 404 of the CWA for placement of dredged or fill material in waters of the United States, and under the Rivers and Harbors Act if it occurs in navigable waters.

As additional experimental compensation to the MSCS measure, DWR and Reclamation will prepare a transplanting plan for the lilaeopsis, adapting the methodology outlined in the monitoring plan for transplanting Mason's lilaeopsis in Barker Slough (California Department of Water Resources 1990b). The plan will include a success criterion for the transplanted plants to achieve 80% survival at the end of a 5-year monitoring period and additional compensatory measures to implement if the survival rate is not achieved.

All unavoidable stands of Mason's lilaeopsis to be removed from the construction area will be salvaged and transplanted to a portion of the created suitable habitat. Areas of occupied habitat should also be considered for enhancement, if transplanting is possible without disturbance of the existing Mason's lilaeopsis plants. DWR and Reclamation will obtain site access through a conservation easement or fee title.

DWR and Reclamation will maintain the transplant areas for a minimum of 5 years, including replanting, removal of trash or debris washed onshore, and removal of nonnative species, if possible, without disturbing the Mason's lilaeopsis plants.

DWR and Reclamation will monitor the transplanted plants for at least 10 years after transplanting, adapting the methods used for the Barker Slough transplanting, as appropriate (California Department of Water Resources 1990b). Monitoring will include measurement of cover of the transplanted plants using large-sized quadrants or, preferably, a transect method. Monitoring will be conducted on a quarterly basis for 1 year, annually for the next 3 years, and once every 2 years for an additional 6 years. For each monitoring period, DWR and Reclamation will submit a report to DFG describing the results of the monitoring period. The reports will include the monitoring data, as well as a discussion of any problems with the plants and the measures implemented or proposed to correct the problems. The reports will also indicate the annual precipitation and note the occurrence of drought conditions or above normal flooding events. This information will assist in evaluating whether the transplanted plants have been able to tolerate more than just normal precipitation years. If the monitoring period has coincided with an extended period of drought or high precipitation, DFG may request additional monitoring to measure the response of transplants to a greater range of natural processes.

Specific mitigation funding sources are not identified at this time, but funding will be required and could include contributions from Proposition 13: Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Act, 2000; Proposition 204 (SB 900): Safe, Clean, Reliable Water Supply Act, 1996; and/or water contractor contributions.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 14, 17, and 19.

Mitigation Measure VEG-MM-6: Monitor Existing Stands of Mason's Lilaeopsis during Gate Operations. During gate operations, DWR and Reclamation will monitor the Mason's lilaeopsis populations identified in the surveys conducted for Mitigation Measure VEG-MM-4. The purpose of monitoring will be to determine whether changes in the tidal zone that occur as a result of gate operations result in any loss of Mason's lilaeopsis. An approximately 1.0-foot lowering of the tidal level is predicted to occur in the area upstream of the gates. DWR and Reclamation will annually monitor the extent and condition of the Mason's lilaeopsis populations identified during preconstruction surveys within 0.5-mile upstream of the gates.

The extent of Mason's lilaeopsis will be monitored, adapting the methods used for the Barker Slough transplanting project, as appropriate (California Department of Water Resources 1990b). Monitoring will include measurement of cover of the Mason's lilaeopsis plants using large-sized quadrats or a transect method. Monitoring of the areas upstream of the gates will be conducted annually for a 5-year period after the gates are constructed (also see Mitigation Measure VEG-MM-10: Monitor Existing Stands of Tidal Emergent Wetland Vegetation During the Gate Operation Phase).

If a decrease in the extent of Mason's lilaeopsis is observed after gate operation begins or anytime during the 5-year monitoring period, DWR and Reclamation will compensate for the loss of this vegetation by implementing Mitigation Measure VEG-MM-5.

Impact VEG-6: Loss or Disturbance of Delta Mudwort Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging. Approximately 40 stands of Delta mudwort were identified in the study area during the 2000–2001 surveys. This number includes stands located approximately 0.5 mile downstream of the Middle River gate site, within the West Canal conveyance dredging area, and at dredge areas for siphon extensions on Victoria and North Canals (Figure 6.2-10).

Gate Construction. Construction activities associated with the Middle River gate would not be expected to affect the Delta mudwort stands located downstream. Construction of the other gates would not be expected to affect Delta mudwort.

Gate Operation. Fewer data on habitat and tolerance of disturbance are available for Delta mudwort than for Mason's lilaeopsis. Because these species often grow in association with each other, however, it is likely that impacts on Delta mudwort because of changes in existing tidal level would be similar to those predicted and described above for Mason's lilaeopsis. However, no Delta mudwort stands were observed in the project area upstream of any of the gates. No extant populations, therefore, would likely be affected by the operation of the gates.

The operation of the permanent gates would not significantly change the tidal levels, flow velocity, or salinity from the existing conditions where Delta mudwort occurs in the project area (see additional discussion of these habitat components under Impact VEG-12). Therefore, no loss of Delta mudwort caused by gate operation is anticipated, and this effect would be considered a less-than-significant impact. No mitigation is required.

Channel Dredging. Conveyance dredging of the West Canal and dredging at the siphon extension locations would avoid direct removal of Delta mudwort but could indirectly affect three stands at the north end of West Canal and up to seven stands on the west half of Victoria and North Canals. Disturbance of the water in the canal during dredging from the barge could result in higher than normal wave action on the shoreline, which could dislodge mudwort plants growing there or wash floating vegetation on top of the plants and smother them. The decrease in water velocity after channel dredging, however, may benefit Delta mudwort and other intertidal plants by reducing erosion of the canal banks. Transport of sediment (scouring) during channel dredging would be minimized to a less-than-significant level by implementing proposed dredging methods (see Impact SS-4).

Disturbance and potential loss of up to 10 stands of Delta mudwort as a result of dredging in the West, Victoria, and North Canals could cause mortality of more than 10% of the approximately 40 stands mapped in the project area. For this reason, project impacts of construction and dredging would be considered significant impacts. However, implementation of mitigation for loss of Mason's lilaeopsis would also benefit Delta mudwort by creating suitable habitat. Mitigation Measures VEG-MM-1, VEG-MM-4, VEG-MM-5, and VEG-MM-6 would reduce this impact to a less-than-significant level.

Impact VEG-7: Loss of Rose-Mallow Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Approximately 36 stands of rose-mallow were identified during the 2000–2001 surveys. The only stands near the project area were located immediately downstream of the Middle River gate site and within the West Canal conveyance dredging area (Figure 6.2-10). Other stands of rose-mallow were observed in Grant Line Canal, but they were more than 1 mile upstream of the proposed gate site.

Gate Construction. Construction activities at the Middle River gate site would not be expected to significantly affect the stands of rose-mallow. Direct or indirect loss of rose-mallow is not expected as a result of project construction.

Gate Operation. In the project area and vicinity, rose-mallow occurs in the intertidal zone and is within approximately 1 mile upstream of the Grant Line Canal gate site and 0.1 mile downstream of the Middle River gate site. As described under Impact VEG-9, the operation of the permanent gates would not substantially change the downstream tidal levels. Operation of the permanent gate on Middle River, therefore, would not cause a discernable change in tidal levels compared to the existing operation of temporary barriers where rose-mallow occurs (Figure 6.2-10; Figures 5.2-33, 5.2-35, 5.2-37, 5.2-39, and 5.2-41; and Impacts HY-3 through HY-7).

The operation of the permanent gates would not substantially change the tidal level, flow velocity, or salinity from the existing conditions in the project area. Therefore, no loss of rose-mallow caused by gate operations would be anticipated, and this effect would be considered a less-than-significant impact. No mitigation is required.

Channel Dredging. Conveyance dredging of the West Canal would be unlikely affect this species because vegetation on the canal banks and on the in-channel island would be avoided by dredging activities. Rose-mallow is a large, robust plant, relative to Mason's lilaeopsis and Delta mudwort, and would not likely be affected by wave action generated by the dredging activities. The decrease in water velocity after channel dredging may benefit rose-mallow and other intertidal plants by reducing erosion of the canal banks. Transport of sediment (scouring) during channel dredging would be minimized to a less-than-significant level by implementing proposed dredging methods (see Impact SS-4).

Dredged material disposal areas to be identified within agricultural lands could include irrigation ditches. Rose-mallow is known to occur in irrigation ditches within its range (California Natural Diversity Database 2004) and, therefore, has the potential to occur in irrigation ditches in dredge disposal areas. If the ditches are not entirely avoided, disposal of dredged material could cover and cause the loss of rose-mallow plants present.

Loss of rose-mallow plants would potentially be a significant impact. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-4, VEG-MM-7, and VEG-MM-8 would reduce this potential impact to a less-than-significant level.

Mitigation Measure VEG-MM-7: Avoid and Minimize Impacts on Special-Status Plants. If any rose-mallow plants or any other special-status plants are found during preconstruction surveys or surveys of dredged material disposal sites and cannot be avoided by construction or dredging activities, DWR and Reclamation will salvage the plants prior to the onset of the activities. Salvaged plants will be immediately transplanted to an area of suitable habitat. For rose-mallow, plants will be transplanted to an area of tidal emergent wetland habitat restored or enhanced as part of Mitigation Measure VEG-MM-7. This mitigation measure is consistent with CALFED Programmatic Mitigation Measure 19.

Mitigation Measure VEG-MM-8: Compensate for Unavoidable Impacts on Tule and Cattail Tidal Emergent Wetlands. DWR and Reclamation will compensate for the unavoidable permanent loss of up to 0.08 acre of tule and cattail tidal emergent wetland as a result of construction of the Middle River gate by restoring or enhancing in-kind habitat at a ratio of 2–3 acres for each acre affected, for a total of 0.16–0.24 acre. Revegetation will be planned and implemented prior to the removal of existing emergent wetland vegetation. This mitigation is consistent with the MSCS Conservation Measure to (CALFED Bay-Delta Program 2000e):

> restore or enhance 2 to 5 acres of additional in-kind habitat for every acre of affected habitat near where impacts are incurred before implementing actions that could result in the loss or degradation of habitat.

As much of the mitigation habitat as possible will be created at or near the Old River at DMC gate site. This mitigation is consistent with the following MSCS Conservation Measure (CALFED Bay-Delta Program 2000e):

> to the extent practicable, include project design features that allow for onsite reestablishment and long-term maintenance of tidal freshwater emergent wetland habitat following project construction.

Mitigation sites will include areas with minimal boat wakes, shallow water, and slow water velocities, and will avoid areas likely to be dredged or where other improvements may be constructed. DWR and Reclamation will obtain site access through a conservation easement or fee title.

If offsite mitigation is necessary, a location that does not currently support tidal flats and that is near ongoing or future ERP projects should be selected. This mitigation is consistent with the following MSCS Conservation Measure (CALFED Bay-Delta Program 2000e):

> to the extent practicable, before restoring habitat in areas that support emergent vegetation, initially restore habitat in locations that do not support tidal emergent vegetation. This will ensure that there is no net loss of habitat over the period that restoration is implemented.

An area that currently supports minimal habitat value, such as the portion of Old River upstream of the proposed fish control gate, would be desirable. If water is too deep at a potential mitigation site, dredged material could be used to construct a bench area as substrate for the tidal emergent wetland habitat. Prior to use, however, such material would be subject to analysis for the presence of contaminants, such as heavy metals. Excessively high levels of contaminants would prohibit the use of dredged materials for bench construction. This mitigation approach is also likely to require permitting under Sections 401 and 404 of the CWA for placement of dredged or fill material in waters of the United States, and under the Rivers and Harbors Act if it occurs in navigable waters.

As described in Mitigation Measure VEG-MM-2, DWR and Reclamation will prepare a revegetation plan to compensate for the loss of emergent wetland habitat and submit the plan to the appropriate regulatory agencies for review. DWR and Reclamation will implement the revegetation plan, maintain plantings, and conduct annual monitoring for 4 years, followed by monitoring every 2 years for the next 6 years. Existing native tidal emergent wetland vegetation from the gate sites should be harvested and maintained for replanting after construction.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, 5, and 6.

Waters of the United States

Impact VEG-8: Filling of Tule and Cattail Tidal Emergent Wetland and Jurisdictional Riparian Communities as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Gate Construction. Construction of the Middle River gate would result in the permanent loss of 0.07 acre of tule and cattail tidal emergent wetland and 0.02 acre of jurisdictional riparian scrub (Table 6.2-3 and Figure 6.2-3). Construction would avoid impacts on the jurisdictional cottonwood-willow woodland and tule and cattail tidal emergent wetland located on the in-channel island in the project area.

Construction of the Grant Line Canal gate would result in the permanent loss of jurisdictional cottonwood-willow woodland and tule and cattail tidal emergent wetland on the in-channel island at the gate (Table 6.2-3 and Figure 6.2-4). Gate construction would permanently remove riparian vegetation along a 10-foot-wide strip across the approximately 125-foot-wide island for placement of buried utilities and construction of a sheetpile wall, resulting in approximately 0.03 acre of fill within the jurisdictional cottonwood-willow woodland wetland and less than 0.01 acre of fill within the tule and cattail wetland. Construction of the gate on the south levee face would permanently remove approximately 0.03 acre of jurisdictional riparian scrub wetland. Permanent loss of this riparian vegetation would be a significant impact.

Construction of the Old River at DMC gate would result in the permanent loss of 0.12 acre of jurisdictional riparian scrub wetland and less than 0.01 acre of tule and cattail tidal emergent wetland adjacent to the gate footprint on the south bank (Table 6.2-4 and Figure 6.2-5).

No tidal emergent wetland or jurisdictional riparian wetlands occur the head of Old River fish control gate site.

Loss of tidal emergent wetland and jurisdictional riparian communities would also result in the loss of suitable habitat in the project area for Suisun Marsh aster, Delta tule pea, slough thistle, Delta coyote-thistle, rose-mallow, Mason’s lilaeopsis, and Delta mudwort. Project construction for the gates would directly remove these habitats, thus decreasing the potential habitat for special-status plants in the project area.

Gate Operation. Jurisdictional tule and cattail tidal emergent wetland and jurisdictional riparian wetlands in the study area occur in the intertidal zone up to the high-tide line on levee banks and on in-channel islands. Wetland vegetation in the study area is partially exposed during low tides and is inundated during high tide. Soils remain saturated within this habitat, but the plants do not require constant inundation. Plants in tule and cattail tidal emergent wetland commonly spread by rhizomes and often have an extensive system of rhizomes within a wetland patch. Woody riparian wetland vegetation commonly has root systems that can access groundwater.

As described in Impact VEG-5, high-tide water levels would remain approximately the same as existing conditions upstream of the gates during gate operation, except at the Grant Line Canal gate, where the high-tide level would decrease by up to 1 foot. Low-tide levels would decrease by up to 1 foot from existing conditions with the temporary barriers during the summer months (Figures 5.2-33, 5.2-37, 5.2-39, and 5.2-41; Impacts HY-3, HY-5, HY-6, and HY-7). The net effect of the project would be an increase in the extent of the intertidal zone by up to 1 foot in the area upstream of each gate (i.e., on Middle River from the gate to Old River; on Grant Line Canal to Old River; and on Old River to the head of Old River). Downstream of the gates during the growing season, water levels would be 2–3 inches lower than existing conditions at low tide and high tide. The net result would be a shifting of the water level downslope in the area downstream of the gate, but there would be no change in the extent of intertidal habitat.

Because of the adaptability of tule and cattail vegetation to alternating inundation and exposure and the rapidity of rhizome growth to colonize new habitat and the rooting depth of woody riparian vegetation, the minor change in tide levels upstream and downstream of the gates under project operations would not likely affect these habitats. Upstream vegetation would potentially increase in area and spread into the new lower-tide area. At the Grant Line Canal gate, the suitable habitat zone would shift downslope by 1 foot. Because the tidal range during project operations would not substantially change from existing conditions, gate operation would not be expected to have a significant impact on the tidal emergent wetland or riparian wetland vegetation. However, Mitigation Measure VEG-MM-9 will be implemented to monitor tidal emergent and riparian wetland vegetation and verify the level of impact during gate operation.

Channel Dredging. Sealed clamshell dredging at the three flow control gate sites and the siphon extension locations and hydraulic or clamshell dredging in the three conveyance dredging areas would not result in any additional direct impacts on tule and cattail tidal emergent wetland (Table 6.2-4 and Figures 6.2-3–6.2-8). Clamshell dredging would avoid direct impacts on tidal emergent wetlands and jurisdictional riparian wetlands. Hydraulic dredging would avoid direct impacts on jurisdictional riparian wetlands.

Indirect impacts of dredging adjacent to the gate sites, at all three conveyance dredging locations, and at the siphon extension locations could include decreased water quality levels caused by turbidity. Tule and cattail emergent wetland vegetation and riparian wetland vegetation would not be significantly affected by the temporary, small increase in channel water turbidity. See Impact WQ-2 for discussion of water quality impacts during dredging.

Dredging at Gate Sites. Dredging of channels adjacent to the gate sites would avoid the areas of tidal emergent wetland. Dredging activities would also avoid direct impacts on jurisdictional riparian wetlands on the in-channel island in the project area. The head of Old River fish control gate project area does not support tidal emergent wetlands or jurisdictional riparian wetlands.

Conveyance Dredging at West Canal. Direct impacts on tule and cattail emergent wetland vegetation would be avoided within the West Canal dredge area. The West Canal supports tidal emergent wetland, primarily on the in-channel island at the north end, in narrow patches along the canal (Table 6.2-3 and Figure 6.2-6). Placement of up to four stationary pipes for transporting dredged material to the existing pond on Fabian Tract and placement of dredged material on levee banks would avoid tidal emergent vegetation.

Conveyance Dredging at Middle River. The Middle River dredge area includes tule and cattail tidal emergent wetland scattered on the banks (Table 6.2-3 and Figure 6.2-7). Temporary impacts within the dredge area could occur as a result of placement of up to 12 stationary pipes that will be used for transporting dredged material. However, the tidal emergent wetland is relatively sparse within this area, and these areas would be avoided during placement of the stationary pipes. A portion of the cottonwood-willow woodland, valley oak riparian woodland, and willow scrub is jurisdictional and occurs on the in-channel islands and below the high-tide line in the proposed dredge area. However, no pipelines or dredged material will be placed on the islands.

Conveyance Dredging at Old River. The Old River dredge area includes tule and cattail tidal emergent wetland on in-channel islands and on channel banks, and some of the riparian vegetation in the area is jurisdictional (Table 6.2-3 and Figure 6.2-8). Temporary impacts of dredging would affect the channel banks on the north side of Stewarts Tract, where up to two stationary pipes for transporting dredged material would be placed. Placement of the two stationary pipes would avoid all areas of tidal emergent wetland.

Spot Dredging at Siphon Locations. Spot dredging at up to 24 locations of the siphon extensions could affect tule and cattail tidal emergent wetland along the channel edges. However, the tidal emergent marsh along channels are generally limited to areas within 10–15 feet of the bank, and these areas would be avoided by dredging activities to the extent feasible. Spot dredging for maintenance of existing agricultural diversions has been addressed in the BO issued by USFWS for the South Delta Temporary Barriers Project. NOAA Fisheries issued BOs for the South Delta Diversions Dredging and Modification Project and the South Delta Temporary Barriers Project (U.S. Fish and Wildlife Service 2001 and National Marine Fisheries Service 2001, 2003 respectively). A Streambed Alteration Agreement (# BD-2002-0002) was issued by the DFG for Dredging and Modification of Selected Diversions in the south Delta. These documents address impacts related to both the dredging and modification of the existing agricultural siphons and pumps in the south Delta. Therefore, there will be no additional consultation related to this impact.

Tule and cattail tidal emergent wetland and jurisdictional riparian wetlands are suitable habitat for a number of special-status plants and are important aquatic wildlife habitats that provide cover and areas for breeding and foraging. Riparian habitat is important to wildlife for breeding and foraging habitat and as movement corridors and links between habitats. These wetlands are regulated by the Corps under Section 404 of the CWA, the Rivers and Harbors Act if tidal or navigable, and by the RWQCB under Section 401 of the CWA. The EPA has an additional oversight role in the regulation of wetlands. Under Section 1600 *et seq.* of the California Fish and Game Code, DFG has jurisdiction over the habitats within the floodplain of the project area channels. DFG additionally considers emergent wetlands and riparian habitat as sensitive natural communities because of their high value to wildlife and documented scarcity in California.

The permanent impact on up to 0.08 acre of tule and cattail tidal emergent wetland and 0.17 acre of jurisdictional riparian scrub wetland at the Middle River, Grant Line Canal, and Old River at DMC gates and on 0.03 acre of jurisdictional cottonwood-willow woodland wetland at the Grant Line Canal gate would be considered significant because the wetlands are waters of the United States and are regulated under Section 404 of the CWA. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-7, and VEG-MM-9 would reduce this impact to a less-than-significant level.

Mitigation Measure VEG-MM-9: Monitor Existing Stands of Tidal Emergent Wetland and Riparian Wetland Vegetation during Gate Operation. DWR and Reclamation will monitor the extent of tidal emergent wetland and riparian wetland vegetation during gate operation to determine whether changes in the tidal zone that occur as a result of gate operations result in the loss of these wetlands. DWR and Reclamation will monitor the extent and condition of the existing tidal emergent wetland and riparian wetlands for a distance of 0.5 mile upstream of the gate for a 5-year period after the gate is constructed.

The extent of tidal emergent wetland and riparian wetlands will be mapped on an aerial photograph and compared to the baseline mapping performed by DWR and Reclamation. If a decrease in tidal emergent wetland or riparian wetland vegetation is observed DWR and Reclamation will compensate for the loss of this vegetation by implementing Mitigation Measures VEG-MM-2 and/or VEG-MM-8.

Impact VEG-9: Filling or Disturbance of Tidal Perennial Aquatic Habitat as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Temporary disturbance of tidal perennial aquatic habitat would occur during construction of the three flow control gates and the fish control gate, channel dredging, and construction of siphon extensions.

Temporary disturbance would occur as a result of any dewatering activities required for gate construction, as well as work in the channel associated with dredging and placement of additional siphon pipeline. Temporary impacts on tidal perennial aquatic habitat are discussed in more detail as they relate to sedimentation and scouring (Section 5.6, Impact SS-1) and fisheries (Section 6.1, Impacts Fish-1, Fish-14, and Fish-21).

Gate Construction. Gate construction would result in the permanent removal of 0.88 acre of tidal perennial aquatic habitat within the gate footprints (Table 6.2-5).

Table 6.2-5. Acreage of Tidal Perennial Aquatic Habitat within the Gate Footprints

Project Component	Tidal Perennial Aquatic Habitat Acreage in Footprint
Middle River flow control gate (two bottom-hinged gates, fish passage, and sheetpile wall)	0.16
Grant Line Canal flow control gate (four bottom-hinged gates and boat lock)	0.32
Old River Delta Mendota Canal (DMC) gate (fish passage and a sheetpile wall)	0.26
Head of Old River fish control gate (bottom-hinged gates and boat lock)	0.14
Total	**0.88**

Tidal perennial aquatic habitat at the four temporary barrier sites is currently affected each year by the placement of fill material to build temporary barriers in the spring and the subsequent removal of the material in the fall. The proposed construction of gates would permanently remove this aquatic habitat within the gate footprint. Structures within the footprint would vary at each gate site but would include gate structures, boat passages, and fish passages (Table 6.2-5). During construction, additional area upstream and downstream of the permanent gate would be temporarily affected for placement of sheetpile-braced cofferdams and channel dredging associated with gate construction.

Gate Operation. Gate operations would not result in an overall loss of tidal perennial aquatic habitat, but zone types could change between deepwater, shallow water, and tidal flats in the area upstream of the gates (i.e., more tidal flat because of the increased tidal range caused by gate operation). The individual acreage of each of these three zones has not been determined; therefore, the potential variation in abundance cannot be determined. The operations-related effect on tidal perennial aquatic habitat, overall, would not be considered significant because these zones would be expected to reestablish as the system adapts to new water level fluctuations.

Channel Dredging. Tidal perennial aquatic habitat in the gate dredging and conveyance dredging areas includes deepwater aquatic, shallow aquatic, and unvegetated intertidal zones. A total of 298.97 acres of tidal perennial aquatic habitat occur in the gate site and conveyance dredging areas. However, impacts from maintenance dredging at the gate sites would be intermittent and primarily would affect water quality. It is assumed that maintenance dredging at the gates and the three dredge areas would affect only the channel bottom and would not affect intertidal vegetation, based on the Project Commitments for the Dredging and Sampling Analysis Plan described in Chapter 2. Impacts from conveyance dredging at the three conveyance dredging sites would occur one time and would be temporary.

Temporary construction staging for the 24 siphon extensions would occupy approximately 100 square feet of channel at each location (Figure 2-8), for a project-wide impact of approximately 0.06 acre (2,400 square feet) of perennial tidal aquatic habitat. Siphon extensions at up to 24 locations would result in a small amount (0.007 acre) of permanent fill of tidal perennial aquatic habitat. Each extension would be extended to a depth of –3 to –5 feet msl. The pipe extensions would be a maximum of 2 feet in diameter and 6 feet in length, for a total of 12 square feet each. The 24 siphon extensions placed within the tidal aquatic area would cover a maximum of 288 square feet (0.007 acre) of the channel bed. Spot dredging for maintenance of existing agricultural diversions has been addressed in the BO issued by USFWS for the South Delta Temporary Barriers Project. NOAA Fisheries issued BOs for the South Delta Diversions Dredging and Modification Project and the South Delta Temporary Barriers Project (U.S. Fish and Wildlife Service 2001 and National Marine Fisheries Service 2003 and 2001 respectively). A Streambed Alteration Agreement (# BD-2002-0002) was issued by the DFG for Dredging and Modification of Selected Diversions in the South Delta. These documents address impacts related to both the dredging and modification of the existing agricultural siphons and pumps in the south Delta. Therefore, there will be no additional consultation related to this impact.

Tidal perennial aquatic habitat is waters of the United States and is regulated by the Corps under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by the DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

Permanent loss of up to 0.88 acre of tidal perennial aquatic habitat would be a significant impact. Implementation of Mitigation Measures VEG-MM-1 and VEG-MM-10, listed below, would reduce this impact to a less-than-significant level.

Mitigation Measure VEG-MM-10: Compensate for Loss of Tidal Perennial Aquatic Habitat. DWR and Reclamation will compensate for the permanent loss of up to 0.88 acre of tidal perennial aquatic habitat caused by construction of the Middle River, Grant Line Canal, Old River at DMC, and head of Old River gates at a ratio of 2–3 acres for each acre affected, for a total of 1.76 to 2.64 acres. This mitigation is consistent with the MSCS conservation measure for tidal perennial aquatic habitat to "restore or enhance 2 to 5 acres of additional in-kind habitat for every acre of affected habitat near where impacts on habitat are incurred" (CALFED Bay-Delta Program 2000a).

DWR and Reclamation would purchase the 1.76 to 2.64 acres of tidal perennial aquatic habitat as mitigation credits from an appropriate mitigation bank in the project vicinity. One potential site is the Kimball Island Mitigation Bank.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, and 5.

Impact VEG-10: Potential Degradation of Wetland Communities as a Result of Release of Contaminants by Channel Dredging.

Dredging in the project area would remove sediments from channel beds. Disruption of buried sediments could carry the risk of exposing and releasing heavy metals into waterways. This potential impact would primarily be a hazard for wildlife that ingest vegetation contaminated by heavy metals or other toxic constituents. However, this potential increase in heavy metals from dredged sediment would not be expected to have a significant effect on vegetation in tule and cattail tidal emergent wetland or jurisdictional riparian wetlands.

The potential for degradation of wetland communities by dredging-released sediment contaminants would be considered a less-than-significant impact. No mitigation is required.

2020 Conditions

The impacts on vegetation and wetlands resulting from implementation of Alternative 2A under 2020 conditions would be similar to those described above. In addition, the same mitigation would apply.

Stage 2 (Operational Component)

Diversions of 8,500 cfs to CCF is not anticipated to result in changes that would affect vegetation beyond those described under Stage 1. There would be no additional impacts associated with implementation of Stage 2, and no mitigation is required.

2020 Conditions

The impacts on vegetation and wetlands resulting from operation of Alternative 2A under 2020 conditions would be similar to 2001 conditions. There would be no additional impacts under 2020 conditions, and no additional mitigation is required.

Interim Operations

Interim operations are expected to have the same impacts on vegetation as existing operations. Interim operations would not result in ground-disturbing activities, and the occasional diversion of 8,500 cfs to CCF is not expected to substantially change the surface elevations of Delta waterways.

Alternative 2B

Stage 1 (Physical/Structural Component)

The impacts on vegetation and wetland resources resulting from construction and operation of gates, dredging, and extension of agricultural diversions of Alternative 2B are the same as those discussed under Alternative 2A (Table 6.2-4). The fish control gate at the head of Old River and the flow control gates in Old River, Grant Line Canal, and Middle River would be constructed in the same locations and the same manner as discussed under Alternative 2A. As a result, the physical/structural component impacts and mitigation measures identified for Alternative 2A would be the same for Alternative 2B.

Stage 2 (Operational Component)

Diversions of 8,500 cfs to CCF is not anticipated to result in noticeable changes beyond those described under Stage 1. There would be no additional impacts associated with implementation of Stage 2, and no mitigation is required.

2020 Conditions

The impacts on vegetation and wetlands resulting from operation of Alternative 2B under 2020 conditions would be similar to 2001 conditions. There would be no additional impacts under 2020 conditions, and no additional mitigation is required.

Alternative 2C

Stage 1 (Physical/Structural Component)

The physical/structural component impacts on vegetation and wetland resources of Alternative 2C are the same as those discussed under Alternative 2A (Table 6.2-4). The fish control gate at the head of Old River and the flow control gates in Old River, Grant Line Canal, and Middle River would be constructed in the same locations and the same manner as discussed under Alternative 2A. As a result, the construction and dredging impacts and mitigation measures identified for Alternative 2A would be the same for Alternative 2C.

Stage 2 (Operational Component)

Diversions of 8,500 cfs to CCF is not anticipated to result in noticeable changes beyond those described under Stage 1. There would be no additional impacts associated with implementation of Stage 2, and no mitigation is required.

2020 Conditions

The impacts on vegetation and wetlands resulting from operation of Alternative 2C under 2020 conditions would be similar to 2001 conditions. There would be no additional impacts under 2020 conditions, and no additional mitigation is required.

Alternative 3B

Stage 1 (Physical/Structural Component)

Land Cover Types

Land cover impact acreages for Alternative 3B are shown in Table 6.2-6.

Impact VEG-1: Loss or Alteration of Nonjurisdictional Woody Riparian Communities as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Gate Construction. Construction of the flow control gate at Old River at DMC would result in the permanent loss of less than 0.01 acre of nonjurisdictional willow scrub (Table 6.2-4). Construction of the Middle River gate would not affect nonjurisdictional riparian vegetation. Loss of jurisdictional woody riparian communities at the gates is discussed under Impact VEG-8. No riparian vegetation occurs at the head of Old River fish control gate site. Sealed clamshell dredging at the two flow control gate sites would avoid impacts on riparian vegetation.

Gate Operation. Nonjurisdictional riparian habitats occupy the area above the existing high-tide levels. Gate operation would not substantially alter the existing high-tide levels from existing conditions in the areas upstream or downstream of the gates. The low-tide level would decrease by approximately 1 foot upstream of the gates and by approximately 2–3 inches in the downstream area, as further discussed under Impact VEG-5. Woody riparian vegetation generally has root systems that can access groundwater when surface water is unavailable. The change in water availability caused by decreased low-tide levels downstream of the gates under project operations would not cause a perceptible change in water availability to riparian vegetation. Because the high tide during project operations would not substantially change from existing conditions and low-tide changes would not be expected to significantly affect riparian vegetation, gate operation is not expected to have a significant impact on the nonjurisdictional riparian vegetation. This alteration would be considered a less-than-significant impact. No mitigation is required.

Channel Dredging. The use of hydraulic dredging in West Canal, Middle River, and Old River would minimize but not entirely avoid temporary impacts on woody riparian vegetation because of the placement of stationary pipes for dredged material on the levee face. Pockets of riparian vegetation occur on the levees between Middle River and Union and Roberts Islands. The exact locations of stationary pipes to transport dredged material over the levees to dredge drying areas are currently unknown, but placement of pipes on the levee

Table 6.2-6. Land Cover Impacts Associated with Gate Construction and Dredging—Alternative 3B

Land Cover Type	Acreages Affected by Gate Construction			Total Permanent Impacts Associated with Gate Construction	Acreages Affected by Dredging[1]					Temporary Impacts Associated with Agricultural Diversions	Permanent Impacts Associated with Agricultural Diversions	Impacts Associated with Dredge Material Disposal[4]
	Middle River Flow Control Gate	Old River at DMC Flow Control Gate	Head of Old River Fish Gate		Permanent Impacts Associated with Dredging at Gate Sites	West Canal Conveyance Dredging Area	Middle River Conveyance Dredging Area	Old River Conveyance Dredging Area	Total Temporary Impacts Associated with Conveyance Dredging			
Tidal perennial aquatic	0.16	0.26	0.14	0.56	19.42	73.02	72.67	123.46	269.15	0.06	<0.01	0
Tule and cattail tidal emergent wetland	0.07	<0.01	0	<0.08	0	0	0	0	0	0	0	0
Cottonwood-willow woodland	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Cottonwood-willow woodland wetland	0	0	0	0		–[2]	–[2]	–[2]	<0.06[2]			0
Valley oak riparian woodland	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub wetland	0.02	0.12	0	0.14		–[2]	–[2]	–[2]	<0.06[2]			0
Willow scrub	0	<0.01	0	0.3	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Willow scrub wetland	0	0	0	0		–[2]	–[2]	–[2]	<0.06[2]			0
Agricultural land	0.50	2.00	0	2.50	3.60[3]	0	0	0		0	0	101.50
Ruderal	0	0	0.02	0.02	0	0	0	0	0	0	0	47.40

Notes:

DMC = Delta-Mendota Canal.

1 Dredge impacts assumed impacts on all tidal perennial aquatic habitat within the dredge area. Actual loss of tidal perennial aquatic habitat will probably be less as a result of confining dredge activities to the center of the channel.

2 Dredge impacts on individual riparian land cover types are not yet determined because the exact placement of the stationary pipes has not been identified. The riparian impact will total up to 0.06 acre at the three dredge areas.

3 The acreage for the gate site agricultural impact includes the areas used for dredge drying areas at all three gate sites, which was assumed to require 1.2 acres at each site. This represents a permanent impact.

4 The acreage for dredge drying areas at the 3 conveyance dredging areas is a temporary impact.

banks would temporarily affect up to a maximum of 16 locations of woody riparian vegetation throughout the three conveyance dredging areas. Assuming removal of vegetation in a 10-foot-wide band for placement of each of the 16 stationary pipes and an estimated levee face height of 15 feet, up to 0.06 acre (2,400 square feet) of woody riparian vegetation would be removed. DWR would avoid placing pipe within woody riparian vegetation to the extent possible. This impact conservatively assumes the maximum possible impact, and the actual impact would likely be less. This effect would continue for up to 5 years after initial dredging until the pipes were removed and the banks would be revegetated. This effect would be a significant impact.

Sealed clamshell dredging of channels, if used in the conveyance dredging areas, would avoid direct impacts on all riparian vegetation. Sealed clamshell dredging at siphon locations would not have an impact on woody riparian vegetation.

Temporary indirect impacts of dredging adjacent to the gate sites, at all three conveyance dredging locations, and at siphon extensions could include decreased water quality levels caused by turbidity. Riparian vegetation near the waterline would not likely be significantly affected by the temporarily small increase in water turbidity. See Impact WQ-2 for discussion of water quality impacts during dredging.

Riparian areas are suitable habitat for special-status plants, are important wildlife habitat for breeding and foraging, and provide movement corridors and links between habitats. DFG considers riparian habitat a sensitive natural community because of its high value to wildlife and its documented scarcity in California.

The temporary impacts on up to 0.06 acre of woody riparian vegetation because of conveyance dredging would be considered significant impacts. These losses of woody riparian vegetation would reduce the extent of riparian communities, which are rare natural communities. Implementation of Mitigation Measure VEG-MM-1, Mitigation Measure VEG-MM-2, and environmental commitments (Chapter 2) would reduce this impact to a less-than-significant level.

Impact VEG-2: Loss of Agricultural Land and Ruderal Vegetation as a Result of Gate Construction and Disposal of Dredged Material.

Agricultural land and ruderal vegetation will be permanently lost as a result of gate construction and dredging at gate sites and dredging at the three conveyance dredging areas. These two components are discussed below.

Gate Construction and Channel Dredging. Construction at the Middle River and Old River at DMC gate sites and the head of Old River fish control gate site would result in the removal of up to6.1 acres of agricultural land and 0.02 acre of ruderal vegetation. Approximately 1.2 acres of agricultural land at each gate site, for a total of 3.6 acres, would be permanently lost because of construction of dredge material disposal areas to contain material from dredging at each gate site.

Conveyance Dredging. Up to 165 acres of settling ponds or runoff management basins for dredged material disposal would be constructed as part of the conveyance-dredging action. The potential locations of the disposal sites have been identified and mapped, although specific sites have not been selected. It is assumed, however, that all dredged material disposal sites would be constructed on agricultural land adjacent to the dredge operations. DWR is committed to minimizing impacts on sensitive habitats, including wetlands and occurrences of special-status species, and will construct the drying areas on agricultural land. These factors will play a major role in the determination of the disposal sites. These ponds or basins would remain in use for up to 7 years and would then be returned to agricultural use.

Siphon Extensions. Dredged material associated with siphon extensions would be placed in the disposal sites described above. Because agricultural land and ruderal communities support few native plant species, have low potential for supporting special-status plant species, and are locally and regionally abundant throughout the Delta, this effect would be a less-than-significant impact from a botanical perspective, and no mitigation is required.

Impact VEG-3: Removal of Giant Reed for Gate Construction.

Within the project area, giant reed is found only at the Grant Line Canal site and, therefore, because Alternative 3B does not include the Grant Line gate, this alternative would have no impact on giant reed. No mitigation is required.

Impact VEG-4: Spread of Noxious Weeds as a Result of Gate Construction and Channel Dredging.

As discussed under Alternative 2A, this effect would be a significant impact. Implementation of Mitigation Measure VEG-MM-3 would reduce this impact to a less-than-significant level.

Special-Status Plants

Impact VEG-5: Loss or Disturbance of Mason's Lilaeopsis Stands or Potential Habitat as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Approximately 175 stands of Mason's lilaeopsis were identified within the study area during the 2000–2001 surveys (Figure 6.2-10). Mason's lilaeopsis stands located near the project area include:

- approximately 20 stands almost 0.5 mile downstream of the Middle River gate site,
- one stand less than 0.25 mile upstream of the Old River at DMC gate site and approximately four stands immediately downstream of the site,
- approximately 17 stands along the West Canal within the proposed conveyance dredging area,
- approximately six stands at siphon extension locations on Victoria and North Canals, and
- approximately four stands at the siphon extension at the confluence of Old River and Grant Line Canal and Fabian and Bell Canal.

Gate Construction. Construction activities associated with the Middle River gate are not anticipated to affect the lilaeopsis stands located downstream. There would be no direct construction impact on these stands. Indirect impacts caused by the spread or introduction of invasive plants or chemical contaminants are unlikely to affect plants nearly 0.5 mile downstream.

Indirect impacts could result from construction activities for the Old River at DMC gate. Construction of the Old River at DMC gate could indirectly affect the approximately five stands upstream of the gate. Construction equipment could spread or introduce plants that compete with Mason's lilaeopsis for mudflat habitat, including pampas grass and water hyacinth. This spread/introduction would be a significant impact. The equipment could also cause water contamination by leaking oil or fuel, which has the potential to be toxic to the established stands of lilaeopsis. However, the potential for water contamination by construction equipment is unlikely to exceed the existing potential for contamination from recreational boats.

Gate Operation. Changes in tidal water levels in the project area would occur because of gate operations. The flow control gates would operate through most of the growing season, as they do under existing conditions. The head of Old River fish control gate would not operate during the summer.

Upstream of the gates during gate operation, high-tide water levels would remain approximately the same as existing conditions. Low-tide levels would decrease by up to 1 foot from existing conditions with the temporary barriers during the summer months (Section 5.2; Figures 5.2-33, 5.2-37, 5.2-39, and 5.2-41; Impacts HY-3, HY-5, HY-6, and HY-7). The net effect of the project would be an increase in the extent of the intertidal zone by up to 1 foot in the area upstream of each gate (i.e., on Middle River from the gate to Old River and on Old River to the head of Old River). This increase would reverse much of the effect on low-tide levels during spring and summer caused by the temporary barriers program. Downstream of the gates during the growing season, water levels would be 2–3 inches lower than existing conditions at low tide and high tide. The net result would be a shifting of the water level downslope in the area downstream of the gate, but there would be no substantial change in the extent of intertidal habitat.

The decrease in low-tide levels upstream of all gates would potentially increase the extent of suitable intertidal habitat for Mason's lilaeopsis. The 1 stand upstream of the Old River at DMC gate would not likely be significantly affected by gate operations.

The Mason's lilaeopsis stands located downstream of the gate sites could experience a shifting of low- and high-tide water levels downslope by 2–3 inches (Section 5.2; Figures 5.2-29 and 5.2-31; Impacts HY-1 and HY-2). Stands of Mason's lilaeopsis closest to CCF occur in areas that would experience the greatest decreases in the tidal water level. The low-tide level would decrease by less than 1 foot, and the high-tide level would decrease by 3 feet but would remain above 2 feet msl (Figure 5.2-31). The lilaeopsis could grow farther downslope to occupy the new intertidal area created by the increased pumping diversions. The decrease in low-tide levels downstream of all gates and in the area near CCF would potentially increase the extent of suitable intertidal habitat for Mason's lilaeopsis. The stands of Mason's lilaeopsis downstream of gates, therefore, would not be significantly affected by project operations.

No significant increase in tidal flow velocity would occur in the project area as a result of the gate operation, and flow velocities would be reduced by the increased conveyance capacity produced by dredging (see Impacts HY-3 through HY-7 in Section 5.2 for additional discussion of changes in tidal flow). This effect would be a less-than-significant impact on Mason's lilaeopsis.

No discernable change in average salinity would be anticipated as a result of gate operations (Section 5.3). The long-term average salinity would be 600–700 µS/cm, which is equivalent to less than 1 ppt (Figures 5.3-15–5.3-17). The salinity objective for project operations is 1,000 µS/cm. Growth of Mason's lilaeopsis is not affected by less than 3 ppt salinity (Fiedler and Zebell 1993). Seed germination is best at 0 ppt salinity, but existing conditions exceed that level. The extent of suitable habitat for Mason's lilaeopsis, therefore, would not be altered as a result of changes in salinity. This effect would be a less-than-significant impact.

Operation of the permanent gates would not be anticipated to affect dispersal of Mason's lilaeopsis upstream or downstream of the gates. The lilaeopsis colonizes new habitat either by seed or vegetative mats of plants that float to new habitat (Golden and Fiedler 1991). Either method requires transportation by water. The permanent gates could block movement upstream and downstream for a substantial portion of the day during the operation periods in spring, summer, and fall. The lilaeopsis propagules (seed or mat), however, would be able to move across the gates during the portion of the day when the gates were open. Implementation of permanent gates, therefore, would not be expected to change the success of colonization of new habitat by Mason's lilaeopsis.

The operation of the permanent gates would not substantially change the upstream or downstream flow velocity, salinity, or dispersal potential from the existing conditions in the project area. Changes in the upstream and downstream tidal water levels from project operation could result in increased suitable habitat for Mason's lilaeopsis and would not have an adverse effect on Mason's lilaeopsis. Although this effect would be considered a less-than-significant impact, Mitigation Measure VEG-MM-6 is included to monitor existing populations during the initial years of gate operation to verify the absence of impact.

Channel Dredging. Conveyance dredging of the West Canal and dredging at the siphon extensions in Victoria, North, Grant Line, and Fabian and Bell Canals would avoid direct removal of Mason's lilaeopsis but could indirectly affect the approximately 27 stands that grow at the edges of the canals in these areas. Disturbance of the water in the canal during dredging from the barge could result in higher-than-normal wave action on the shoreline, which could dislodge lilaeopsis plants growing there or possibly wash floating vegetation on top of the plants, which would smother them. This disturbance would be a significant impact. Dredge equipment also has the potential to contaminate the water with oil or fuel, which may be toxic to the lilaeopsis, but is unlikely to exceed existing potential for water contamination produced by boats.

The decrease in water velocity after channel dredging may benefit Mason's lilaeopsis and other intertidal plants by reducing erosion of the canal banks. Transport of sediment (scouring) during channel dredging would be minimized to a less-than-significant level by implementing proposed dredging methods (Impact SS-4).

Mason's lilaeopsis is a state-listed rare species restricted to small areas of ephemeral habitat and susceptible to adverse impacts by direct and indirect habitat loss. The project would result in potential indirect impacts on up to 32 stands at the Old River at DMC gate site and dredging areas within the West, Victoria, North, Grant Line, and Fabian and Bell Canals. Including disturbances that could eradicate the stands, the project could cause mortality of more than 10% of the approximately 175 stands mapped in the project area. For this reason, the indirect impacts of construction and dredging would be considered significant impacts. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-4, VEG-MM-5, and VEG-MM-6 would reduce these impacts to a less-than-significant level.

Impact VEG-6: Loss or Disturbance of Delta Mudwort Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging.

As discussed under Alternative 2A, this loss/disturbance would be considered a significant impact. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-4, VEG-MM-5, and VEG-MM-6 would reduce this impact to a less-than-significant level.

Impact VEG-7: Loss of Rose-Mallow Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging.

As discussed under Alternative 2A, this loss would be a potentially significant impact. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-4, VEG-MM-7, and VEG-MM-8 would reduce this potential impact to a less-than-significant level.

Waters of the United States

Impact VEG-8: Filling of Tule and Cattail Tidal Emergent Wetland and Jurisdictional Riparian Communities as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Gate Construction. Construction of the Middle River gate would result in the permanent loss of 0.07 acre of tule and cattail tidal emergent wetland and 0.02 acre of jurisdictional riparian scrub (Table 6.2-3 and Figure 6.2-3). Construction would avoid impacts on the jurisdictional cottonwood-willow woodland and tule and cattail tidal emergent wetland located on the in-channel island in the project area.

Construction of the Old River at DMC gate would result in the permanent loss of 0.12 acre of jurisdictional riparian scrub wetland and less than 0.01acre of tule and cattail tidal emergent wetland adjacent to the gate footprint on the south bank (Table 6.2-6 and Figure 6.2-5). This loss would be a significant impact.

No tidal emergent wetland occurs at the Middle River or head of Old River fish control gate sites, and no jurisdictional riparian habitats occur at the three flow control gate sites.

Loss of tidal emergent wetland habitat would also result in the loss of suitable habitat in the project area for Suisun Marsh aster, Delta tule pea, slough thistle, rose-mallow, Mason's lilaeopsis, and Delta mudwort. Project construction for the gates would directly remove these habitats, thus decreasing the potential habitat for special-status plants in the project area.

Gate Operation. Jurisdictional tule and cattail tidal emergent wetland and jurisdictional riparian wetlands in the study area occur in the intertidal zone up to the high-tide line on levee banks and on in-channel islands. Wetland vegetation in the study area is partially exposed during low tides and is inundated during high tide. Soils remain saturated within this habitat, but the plants do not require constant inundation. Plants in tule and cattail tidal emergent wetland commonly spread by rhizomes and often have an extensive system of rhizomes within a wetland patch. Woody riparian wetland vegetation commonly has root systems that can access groundwater.

As described in Impact VEG-5, high-tide water levels would remain approximately the same as existing conditions upstream of the gates during gate operation. Low-tide levels would decrease by up to 1 foot from existing conditions with the temporary barriers during the summer months (Figures 5.2-33, 5.2-37, 5.2-39, and 5.2-41; Impacts HY-3, HY-5, HY-6, and HY-7). The net effect of the project would be an increase in the extent of the intertidal zone by up to 1 foot in the area upstream of each gate (i.e., on Middle River from the gate to Old River and on Old River to the head of Old River). Downstream of the gates during the growing season, water levels would be 2–3 inches lower than existing conditions at low tide and high tide. The net result would be a shifting of the water level downslope in the area downstream of the gate, but there would be no change in the extent of intertidal habitat.

Because of the adaptability of tule and cattail vegetation to alternating inundation and exposure and the rapidity of rhizome growth to colonize new habitat and the rooting depth of woody riparian vegetation, the minor change in tide levels upstream and downstream of the gates under project operations would not likely affect these habitats. Upstream vegetation would potentially increase in area and spread into the new lower-tide area. Because the tidal range during project operations would not substantially change from existing conditions, gate operation would not be expected to have a significant impact on the tidal emergent wetland or riparian wetland vegetation. However, Mitigation Measure VEG-MM-9 will be implemented to monitor tidal emergent and riparian wetland vegetation and verify the level of impact during gate operation.

Channel Dredging. Sealed clamshell dredging at the three flow control gate sites and the siphon extension locations and hydraulic or clamshell dredging in the three proposed conveyance dredging areas would not result in additional direct impacts on tule and cattail tidal emergent wetland (Table 6.2-3 and Figures 6.2-3–6.2-8). Clamshell dredging would avoid direct impacts on tidal emergent wetlands and jurisdictional riparian wetland. Hydraulic dredging would also avoid direct impacts on jurisdictional riparian wetlands.

Indirect impacts of dredging adjacent on the gate sites, at all three conveyance dredging locations, and at the siphon extension locations could include decreased water quality levels because of turbidity. Tule and cattail emergent wetland vegetation and riparian wetland vegetation would not be significantly affected by the temporarily small increase in turbidity of channel water. See Impact WQ-2 for discussion of water quality impacts during dredging.

Dredging at Gate Sites. At the Old River at DMC gate, no impacts on tidal emergent wetland, beyond those from the gate construction, would occur. The Middle River and head of Old River fish control gate sites do not support tidal emergent or jurisdictional riparian wetlands.

Conveyance Dredging at West Canal. Direct impacts on tule and cattail emergent wetland vegetation would be avoided within the West Canal dredge area. The West Canal supports tidal emergent wetland, primarily on the in-channel island at the north end, in narrow patches along the canal (Table 6.2-3 and Figure 6.2-6). Placement of up to four stationary pipes for transporting dredged material to the existing pond on Fabian Tract and placement of dredged material on levee banks would avoid tidal emergent vegetation.

Conveyance Dredging at Middle River. The Middle River dredge area includes tule and cattail tidal emergent wetland scattered on the banks (Table 6.2-3 and Figure 6.2-7). Temporary dredge impacts within the dredge area could occur because of placement of up to 12 stationary pipes for transporting dredged material. However, tidal emergent wetland is relatively sparse within this area and would be avoided when placing the stationary pipes. A portion of the cottonwood-willow woodland, valley oak riparian woodland, and willow scrub is jurisdictional and occurs on the in-channel islands and below the high-tide line in the proposed dredge area. However, no pipelines or dredged material would be placed on the islands.

Dredging at Old River. The Old River dredge area includes tule and cattail tidal emergent wetland on in-channel islands and on channel banks, and a portion of the riparian vegetation is jurisdictional (Table 6.2-3 and Figure 6.2-8). Temporary impacts of dredging would affect the channel banks on the north side of Stewarts Tract, where up to two stationary pipes for transporting dredged material would be placed. Placement of the two stationary pipes would avoid all areas of tidal emergent wetland.

Spot Dredging at Siphon Locations. Spot dredging at up to 24 locations of the siphon extensions could affect tule and cattail tidal emergent wetland located at the channel edges. However, the tidal emergent marsh along channels are generally limited to areas within 10–15 feet of the bank, and these areas would be avoided by dredging activities to the extent feasible. Spot dredging for maintenance of existing agricultural diversions has been addressed in the BO issued by USFWS for the South Delta Temporary Barriers Project. NOAA Fisheries issued BOs for the South Delta Diversions Dredging and Modification Project and the South Delta Temporary Barriers Project (U.S. Fish and Wildlife Service 2001 and National Marine Fisheries Service 2003 and 2001 respectively). A Streambed Alteration Agreement (# BD-2002-0002) was issued by the DFG for Dredging and Modification of Selected Diversions in the South Delta. These documents address impacts related to both the dredging and modification of the existing agricultural siphons and pumps in the south Delta. Therefore, there will be no additional consultation related to this impact.

Tule and cattail tidal emergent wetland and jurisdictional riparian wetlands are suitable habitat for a number of special-status plants and are important aquatic wildlife habitats that provide cover and areas for breeding and foraging. Riparian habitat is important wildlife habitat for breeding and foraging and provides movement corridors and links between habitats. These wetlands are regulated by the Corps under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA. The EPA has an additional oversight role in the regulation of wetlands. Under Section 1600 *et seq.* of the California Fish and Game Code, DFG has jurisdiction over the habitats within the floodplain of the project area channels. DFG additionally considers emergent wetlands and riparian habitat as sensitive natural communities because of their high value to wildlife and documented scarcity in California.

The permanent impacts on up to 0.08 acre of tule and cattail tidal emergent wetland and 0.14 acre of jurisdictional riparian scrub wetland at the Middle River and at the Old River at DMC gate would be considered a significant impact because the wetland is waters of the United States and is regulated under Section 404 of the CWA. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-2, VEG-MM-7, and VEG-MM-9 would reduce this impact to a less-than-significant level.

Impact VEG-9: Filling or Disturbance of Tidal Perennial Aquatic Habitat as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Temporary disturbance of tidal perennial aquatic habitat would occur during construction of the three flow control gates and the fish control gate, dredging of the channel, and construction of the siphon extensions. Temporary disturbance would occur because of any dewatering activities required for gate construction, as well as work in the channel associated with dredging and placement of additional siphon pipeline. Temporary impacts on tidal perennial aquatic habitat are discussed in more detail as they relate to sedimentation and scouring (Section 5.6, Impact SS-1) and fisheries (Section 6.1, Impacts Fish-1, Fish-14, and Fish-21).

Gate Construction. Gate construction would also result in the permanent removal of 0.56 acre of tidal perennial aquatic habitat within the Middle River, Old River at DMC, and Head of Old River gate footprints (Table 6.2-6, Impact VEG-9).

Tidal perennial aquatic habitat at the three gate sites is currently affected each year by the placement of fill material to build temporary barriers in the spring and the subsequent removal of the material in the fall. The proposed construction of gates would permanently remove this aquatic habitat within the gate footprint. Structures within the footprint vary at each gate site but include gate structures, boat passages, and fish passages (Table 6.2-5). During construction, additional area upstream and downstream of the permanent gate would be temporarily affected for placement of sheetpile-braced cofferdams and dredging associated with gate construction.

Gate Operation. Gate operations would not result in an overall loss of tidal perennial aquatic habitat, but zone types could change between deepwater, shallow water, and tidal flats in the area upstream of the gates (i.e., more tidal flat because of the increased tidal range caused by gate operation). The individual acreage of each of these three zones has not been determined; therefore, the potential variation in abundance cannot be determined. The operations-related effect on tidal perennial aquatic habitat, overall, would not be considered significant because these zones would be expected to reestablish as the system adapts to new water level fluctuations.

Channel Dredging. Tidal perennial aquatic habitat in the gate dredging and conveyance dredging areas includes deepwater aquatic, shallow aquatic, and unvegetated intertidal zones. A total of 288.57 acres of tidal perennial aquatic habitat occurs in the gate site and conveyance dredging areas. However, impacts from maintenance dredging at the gate sites would be intermittent and primarily would affect water quality. It is assumed that maintenance dredging at the gates and the three dredge areas would affect only the channel bottom and would not affect intertidal vegetation, based on the Project Commitments for the Dredging and Sampling Analysis Plan described in Chapter 2. Impacts from conveyance dredging at the three conveyance dredging sites would occur one time and would be temporary.

Temporary construction staging for the 24 siphon extensions would occupy approximately 100 square feet of channel at each location (Figure 2-8) for a project-wide impact of approximately 0.06 acre (2,300 square feet) of perennial tidal aquatic habitat. Siphon extensions at up to 24 locations would result in a small amount (0.007 acre) of permanent fill of tidal perennial aquatic habitat. Each extension would be extended to a depth of -3 to -5 feet msl. The pipe extensions would be a maximum of 2 feet in diameter and 6 feet in length, for a total of 12 square feet each. The 24 siphon extensions placed within the tidal aquatic area would cover a maximum of 288 square feet (0.007 acre) of the channel bed. Spot dredging for maintenance of existing agricultural diversions has been addressed in the BO issued by USFWS for the South Delta Temporary Barriers Project. NOAA Fisheries issued BOs for the South Delta Diversions

Dredging and Modification Project and the South Delta Temporary Barriers Project (U.S. Fish and Wildlife Service 2001 and National Marine Fisheries Service 2003 and 2001 respectively). A Streambed Alteration Agreement (# BD-2002-0002) was issued by the DFG for Dredging and Modification of Selected Diversions in the South Delta. These documents address impacts related to both the dredging and modification of the existing agricultural siphons and pumps in the south Delta. Therefore, there will be no additional consultation related to this impact.

Tidal perennial aquatic habitat is waters of the United States and is regulated by the Corps under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

Permanent loss of 0.56 acre of tidal perennial aquatic habitat at the gate sites would be a significant impact. Implementation of Mitigation Measures VEG-MM-1 and VEG-MM-10 would reduce this impact to a less-than-significant level.

Impact VEG-10: Potential Degradation of Wetland Communities as a Result of Release of Contaminants by Channel Dredging.

As discussed under Alternative 2A, this effect would be considered a less-than-significant impact. No mitigation is required.

2020 Conditions

The impacts on vegetation and wetlands resulting from implementation of Alternative 3B under 2020 conditions would be similar to those described above. In addition, the same mitigation would apply.

Stage 2 (Operational Component)

Diversions of 8,500 cfs to CCF is not anticipated to result in noticeable changes beyond those described under Stage 1. There would be no additional impacts associated with implementation of Stage 2, and no mitigation is required.

2020 Conditions

The impacts on vegetation and wetlands resulting from operation of Alternative 3B under 2020 conditions would be similar to 2001 conditions. There would be no additional impacts under 2020 conditions, and no additional mitigation is required.

Alternative 4B

Stage 1 (Physical/Structural Component)

Land Cover Types

Land cover impact acreages for Alternative 4B are shown in Table 6.2-7.

Impact VEG-1: Loss or Alteration of Nonjurisdictional Woody Riparian Communities as a Result of Gate Construction, Gate Operation, and Channel Dredging.

No riparian vegetation occurs at the head of Old River fish control gate site, and there would be no impact on riparian vegetation as a result of gate construction, gate operation, or dredging.

If sealed clamshell dredging were used within the three conveyance dredging areas, there would be no direct impacts on riparian vegetation.

The use of hydraulic dredging in West Canal, Middle River, and Old River would minimize but not entirely avoid temporary impacts on woody riparian vegetation because of the placement of the stationary pipes for dredged material on the levee face. Pockets of riparian vegetation occur on the levees between Middle River and Union and Roberts Islands. The exact locations of stationary pipes to transport dredged material over the levees to dredged material disposal areas are currently unknown, but placement of pipes on the levee banks would temporarily affect up to a maximum of 16 locations of woody riparian vegetation throughout the three conveyance dredging areas. Assuming removal of vegetation in a 10-foot-wide band for placement of each of the 16 stationary pipes and an estimated levee face height of 15 feet, up to 0.06 acre (2,400 square feet) of woody riparian vegetation would be removed. DWR would avoid placing pipe within woody riparian vegetation to the extent possible. This impact conservatively assumes the maximum possible impact, and the actual impact would likely be less. This effect would continue for up to 5 years after initial dredging, until the pipes were removed and the banks were revegetated. This effect would be a significant impact.

Sealed clamshell dredging at siphon locations would not have an impact on woody riparian vegetation.

Temporary indirect impacts of dredging adjacent on the gate sites, at all three conveyance dredging locations, and at siphon extensions could include decreased water quality levels caused by turbidity. Riparian vegetation near the waterline would not likely be significantly affected by the temporarily small increase in water turbidity. See Impact WQ-2 for discussion of water quality impacts during dredging.

Riparian areas are suitable habitat for special-status plants, are important wildlife habitat for breeding and foraging, and provide movement corridors and links between habitats. DFG considers riparian habitat a sensitive natural community because of its high value to wildlife and its documented scarcity in California.

The temporary impacts on 0.06 acre of woody riparian vegetation as a result of conveyance dredging would be considered significant because losses of woody riparian vegetation would reduce the extent of riparian communities, which are rare natural communities. Implementation of Mitigation Measure VEG-MM-1, Mitigation Measure VEG-MM-2, and environmental commitments (Chapter 2) would reduce this impact to a less-than-significant level.

Impact VEG-2: Loss of Agricultural Land and Ruderal Vegetation as a Result of Gate Construction and Disposal of Dredged Material. Agricultural land and ruderal vegetation will be permanently lost as a result of gate construction and dredging at the Old River fish control gate site and as a result of dredging at the three conveyance dredging areas. These two components are discussed below.

Gate Construction and Channel Dredging. Construction at the head of Old River fish control gate site would result in the removal of approximately 1.2 acres of agricultural land and 0.02 acre of ruderal vegetation. Approximately 1.2 acres of the agricultural land would be permanently lost because of construction of dredge drying areas to contain material from dredging at each gate site.

Conveyance Dredging. Up to 165 acres of settling ponds or runoff management basins for dredged material disposal will be constructed as part of the conveyance dredging action. The potential locations of the settling ponds or runoff management basins have been identified and mapped, although specific sites have not been selected. It is assumed, however, that all dredged material disposal areas would be constructed on agricultural land adjacent to the dredge operations. DWR is committed to minimizing impacts on sensitive habitats, including wetlands and occurrences of special-status species, and will construct the ponds or basins on agricultural land. These factors will play a major role in the determination of the dredged material disposal sites. These sites would remain in use for up to 7 years and would then be returned to agricultural use.

Siphon Extensions. Dredged material associated with siphon extensions would be placed in the disposal sites described above.

Because agricultural land and ruderal communities support few native plant species, have low potential for supporting special-status plant species, and are locally and regionally abundant throughout the Delta, this effect would be a less-than-significant impact from a botanical perspective, and no mitigation is required.

Impact VEG-3: Removal of Giant Reed for Gate Construction. Within the project area, giant reed is found only at the Grant Line Canal site. Because Alternative 4B does not include the Grant Line gate, this alternative will have no affect on giant reed. No mitigation is required.

Table 6.2-7. Land Cover Impacts Associated with Gate Construction and Dredging—Alternative 4B

Land Cover Type	Permanent Impacts Associated with Gate Construction	Acreages Affected by Dredging[1]					Temporary Impacts Associated with Agricultural Diversions	Permanent Impacts Associated with Agricultural Diversions	Impacts Associated with Dredge Material Disposal[4]
		Permanent Impacts Associated with Dredging at Head of Old River Fish Gate Site	West Canal Conveyance Dredging Area	Middle River Conveyance Dredging Area	Old River Conveyance Dredging Area	Total Temporary Impacts Associated with Conveyance Dredging			
Tidal perennial aquatic	0.14	7.58	73.02	72.67	123.46	269.15	0.06	<0.01	0
Tule and cattail tidal emergent wetland	0	0	0	0	0	0	0	0	0
Cottonwood-willow woodland	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Cottonwood-willow woodland wetland			–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Valley oak riparian woodland	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub wetland	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Willow scrub	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Willow scrub wetland	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Agricultural land	0	1.20[3]	0	0	0	0	0	0	101.50
Ruderal	0.02	0	0	0	0	0	0	0	47.40

Notes:

1 Dredge impacts assumed impacts on all tidal perennial aquatic habitat within the dredge area. Actual loss of tidal perennial aquatic habitat will probably be less as a result of confining dredge activities to the center of the channel.

2 Dredge impacts on individual riparian land cover types are not yet determined because the exact placement of the stationary pipes has not been identified. The riparian impact will total up to 0.06 acre at the three dredge areas.

3 The acreage for the gate site agricultural impact includes the areas used for dredge drying areas at the gate site, which was assumed to require 1.2 acres. This represents a permanent impact.

4 The acreage for dredge drying areas at the 3 conveyance dredging areas is a temporary impact.

Impact VEG-4: Spread of Noxious Weeds as a Result of Gate Construction and Channel Dredging.

As discussed under Alternative 2A, this effect would be a significant impact. Implementation of Mitigation Measure VEG-MM-3 would reduce this impact to a less-than-significant level.

Special-Status Plants

Impact VEG-5: Loss or Disturbance of Mason's Lilaeopsis Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Approximately 175 stands of Mason's lilaeopsis were identified within the study area during the 2000–2001 surveys (Figure 6.2-10). No stands occur in the vicinity of the head of Old River fish control gate and no impacts on Mason's lilaeopsis are anticipated due to gate construction or operation. Mason's lilaeopsis stands identified near the project area include:

- approximately 17 stands along the West Canal within the proposed conveyance dredging area,
- approximately six stands at siphon extension locations on Victoria and North Canals, and
- approximately four stands at the siphon extension at the confluence of Old River and Grant Line Canal and Fabian and Bell Canal.

Conveyance dredging of the West Canal and dredging at siphon extensions in Victoria, North, Grant Line, and Fabian and Bell Canals would avoid direct removal of Mason's lilaeopsis but could indirectly affect up to 27 stands that grow at the edges of the canals in these areas. Disturbance of the water in the canal from the barge during dredging could result in higher than normal wave action on the shoreline, which could dislodge lilaeopsis plants growing there or possibly wash floating vegetation on top of the plants, which would smother them. This effect would be a significant impact. Dredge equipment also has the potential to contaminate the water with oil or fuel, which may be toxic to the lilaeopsis, but is unlikely to exceed existing potential for water contamination produced by boats.

The decrease in water velocity after channel dredging may benefit Mason's lilaeopsis and other intertidal plants by reducing erosion of the canal banks. Transport of sediment (scouring) during channel dredging would be minimized to a less-than-significant level by implementing proposed dredging methods (Impact SS-4).

Mason's lilaeopsis is a state-listed rare species restricted to small areas of ephemeral habitat and susceptible to adverse effects by direct and indirect habitat loss. Disturbance of up to 27 stands would occur because of potential indirect impacts at the Grant Line Canal and Old River sites and because of indirect impacts of dredging activities in the West, Victoria, North, Grant Line, and Fabian and Bell Canals. Including disturbances that could eradicate the stands, the project could, therefore, cause mortality of more than 10% of the approximately 175 stands mapped in the project area. For this reason, the indirect impacts of construction and dredging would be considered significant impacts. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-4, VEG-MM-5, and VEG-MM-6 would reduce this impact to a less-than-significant level.

Impact VEG-6: Loss or Disturbance of Delta Mudwort Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging. As discussed under Alternative 2A, this loss/disturbance would be considered a significant impact. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-4, VEG-MM-5, and VEG-MM-6 would reduce this impact to a less-than-significant level.

Impact VEG-7: Loss of Rose-Mallow Stands as a Result of Gate Construction, Gate Operation, and Channel Dredging.
As discussed under Alternative 2A, this loss would be a potentially significant impact. Implementation of Mitigation Measures VEG-MM-1, VEG-MM-4, VEG-MM-7, and VEG-MM-8 would reduce this potential impact to a less-than-significant level.

Waters of the United States

Impact VEG-8: Filling of Tule and Cattail Tidal Emergent Wetland and Jurisdictional Riparian Wetlands as a Result of Gate Construction, Gate Operation, and Channel Dredging.
No tidal emergent wetland or jurisdictional riparian wetlands occur at the head of Old River fish control gate site, and there would be no impact on these wetlands caused by gate construction, gate operation, or channel dredging at the gate.

Hydraulic dredging at the three proposed conveyance dredging areas and sealed clamshell dredging at the siphon extension locations would not result in any additional direct impacts on tule and cattail tidal emergent wetland (Table 6.2-7 and Figures 6.2-3–6.3-8). Hydraulic dredging would also avoid direct impacts on jurisdictional riparian wetlands. Clamshell dredging would avoid direct impacts on tidal emergent wetlands and jurisdictional riparian wetlands.

Indirect impacts of dredging at all three conveyance dredging locations and siphon extension locations could include decreased water quality levels as a result of turbidity. Tule and cattail emergent wetland vegetation and riparian wetland vegetation would not be significantly affected by the temporarily small increase in turbidity of channel water. See Impact WQ-2 for discussion of water quality impacts during dredging.

Conveyance Dredging at West Canal. Direct impacts on tule and cattail emergent wetland vegetation would be avoided within the West Canal dredge area. The West Canal supports tidal emergent wetland, primarily on the in-channel island at the north end, in narrow patches along the canal (Table 6.2-3 and Figure 6.2-6). Placement of up to four stationary pipes for transporting dredged material to the existing pond on Fabian Tract, and placement of dredged material on levee banks would avoid tidal emergent vegetation.

Conveyance Dredging at Middle River. The Middle River dredge area includes tule and cattail tidal emergent wetland scattered on the banks (Table 6.2-3 and Figure 6.2-7). Temporary dredge impacts within the dredge area could occur because of placement of up to 12 stationary pipes for transporting dredged material and placement of dredged material on the levee bank. However, the tidal emergent wetland is relatively sparse within this area, and these areas would be avoided when placing the stationary pipes. A portion of the cottonwood-willow woodland, valley oak riparian woodland, and willow scrub is jurisdictional and occurs on the in-channel islands and below the high-tide line in the proposed dredge area. However, no pipelines or dredged material will be placed on the islands.

Conveyance Dredging at Old River. The Old River dredge area includes tule and cattail tidal emergent wetland on in-channel islands and on channel banks, and a portion of the riparian vegetation is jurisdictional (Table 6.2-3 and Figure 6.2-8). Temporary impacts of dredging would affect the channel banks on the north side of Stewarts Tract where up to two stationary pipes for transporting dredged material would be placed. Placement of the two stationary pipes would avoid all areas of tidal emergent wetland.

Spot Dredging at Siphon Locations. Spot dredging at up to 24 locations of the siphon extensions could affect tule and cattail tidal emergent wetland located at the channel edges. However, the tidal emergent marshes along channels are generally limited to areas within 10–15 feet of the bank, and these areas would be avoided by dredging activities to the extent feasible. Spot dredging for maintenance of existing agricultural diversions has been addressed in the BO issued by USFWS for the South Delta Temporary Barriers Project. NOAA Fisheries issued BOs for the South Delta Diversions Dredging and Modification Project and the South Delta Temporary Barriers Project (U.S Fish and Wildlife Service 2001 and National Marine Fisheries Service 2003 and 2001 respectively). A Streambed Alteration Agreement (# BD-2002-0002) was issued by the DFG for Dredging and Modification of Selected Diversions in the South Delta. These documents address impacts related to both the dredging and modification of the existing agricultural siphons and pumps in the south Delta. Therefore, there will be no additional consultation related to this impact.

Tule and cattail tidal emergent wetland and jurisdictional riparian wetlands are suitable habitat for a number of special-status plants and are important aquatic wildlife habitats that provide cover and areas for breeding and foraging. Riparian habitat is important wildlife habitat for breeding and foraging and provides movement corridors and links between habitats. These wetlands are regulated by the Corps under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA. The EPA has an additional oversight role in the regulation of wetlands. Under Section 1600 *et seq.* of the California Fish and Game Code, DFG has jurisdiction over the habitats within the floodplain of the project area channels. DFG additionally considers emergent wetlands and riparian habitat as sensitive natural communities because of their high value to wildlife and documented scarcity in California.

No temporary or permanent impacts on tule and cattail tidal emergent wetland or jurisdictional riparian wetlands would occur because of the construction of the head of Old River fish control gate or dredging at the gate and the three conveyance dredging areas. No mitigation is required.

Impact VEG-9: Filling or Disturbance of Tidal Perennial Aquatic Habitat as a Result of Gate Construction, Gate Operation, and Channel Dredging.

Temporary disturbance of tidal perennial aquatic habitat would occur during construction of the head of Old River fish control gate, dredging of the channel, and construction of the siphon extensions. Temporary disturbance would occur because of any dewatering activities required for gate construction, as well as work in the channel associated with dredging and placement of additional siphon pipeline. Temporary impacts on tidal perennial aquatic habitat are discussed in more detail as they relate to sedimentation and scouring (Section 5.6, Impact SS-1) and fisheries (Section 6.1, Impacts Fish-1, Fish-14, and Fish-21).

Gate Construction. Tidal perennial aquatic habitat at the gate site is currently affected each year by the placement of fill material to build a temporary barrier in the spring and in the fall. The proposed construction of the gate would permanently remove 0.14 acre of this aquatic habitat within the gate footprint. Structures within the footprint at the gate site include a hinged-bottom gate structure and a boat lock. During construction, additional area upstream and downstream of the permanent gate would be temporarily affected for placement of sheetpile-braced cofferdams and dredging associated with gate construction.

Gate Operation. Gate operations would not result in an overall loss of tidal perennial aquatic habitat, but zone types could change between deepwater, shallow water, and tidal flats in the area upstream of the gates (i.e., more tidal flat because of the increased tidal range caused by gate operation). The individual acreage of each of these three zones has not been determined; therefore, the potential variation in abundance cannot be determined. The operations-related effect on tidal perennial aquatic habitat, overall, would not be considered significant because these zones would be expected to reestablish as the system adapts to new water level fluctuations.

Channel Dredging. Tidal perennial aquatic habitat in the gate dredging and conveyance dredging areas includes deepwater aquatic, shallow aquatic, and unvegetated intertidal zones. A total of 298.97 acres of tidal perennial aquatic habitat occur in the gate site and conveyance dredging areas. However, impacts from maintenance dredging at the gate sites would be intermittent and primarily would affect water quality. It is assumed that maintenance dredging at the gates and the three dredge areas would affect only the channel bottom and would not affect intertidal vegetation, based on the Project Commitments for the Dredging and Sampling Analysis Plan described in Chapter 2. Impacts from conveyance dredging at the three conveyance dredging sites would occur one time and would be temporary.

Temporary construction staging for the 24 siphon extensions would occupy approximately 100 square feet of channel at each location (Figure 2-8) for a project-wide impact of approximately 0.06 acre (2,300 square feet) of perennial tidal aquatic habitat. Siphon extensions at up to 24 locations would result in a small amount (0.007 acre) of permanent fill of tidal perennial aquatic habitat. Each extension would be extended to a depth of -3 to -5 feet msl. The pipe extensions would be a maximum of 2 feet in diameter and 6 feet in length, for a total of 12 square feet each. The 24 siphon extensions placed within the tidal aquatic area would cover a maximum of 288 square feet (0.007 acre) of the channel bed. Spot dredging for maintenance of existing agricultural diversions has been addressed in the BO issued by USFWS for the south Delta temporary barriers program. NOAA issued BOs for the South Delta Diversions Dredging and Modification Project and the South Delta Temporary Barriers Project (U.S. Fish and Wildlife Service 2001 and National Marine Fisheries Service 2003 and 2001 respectively). A Streambed Alteration Agreement (# BD-2002-0002) was issued by the DFG for Dredging and Modification of Selected Diversions in the South Delta. These documents address impacts related to both the dredging and modification of the existing agricultural siphons and pumps in the south Delta. Therefore, there will be no additional consultation related to this impact.

Tidal perennial aquatic habitat is waters of the United States and is regulated by the Corps under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

Permanent loss of 0.14 acre of tidal perennial aquatic habitat at the gate construction site would be a significant impact. Implementation of Mitigation Measures VEG-MM-1 and VEG-MM-10 would reduce this impact to a less-than-significant level.

Impact VEG-10: Potential Degradation of Wetland Communities as a Result of Release of Contaminants by Channel Dredging.

As discussed under Alternative 2A, this effect would be considered a less-than-significant impact. No mitigation is required.

2020 Conditions

The impacts on vegetation and wetlands resulting from the physical/structural component of Alternative 4B under 2020 conditions would be similar to those described above. In addition, the same mitigation would apply.

Stage 2 (Operational Component)

Diversions of 8,500 cfs to CCF is not anticipated to result in noticeable changes beyond those described under Stage 1. There would be no additional impacts associated with implementation of Stage 2, and no mitigation is required.

2020 Conditions

The impacts on vegetation and wetlands resulting from operation of Alternative 4B under 2020 conditions would be similar to 2001 conditions. There would be no additional impacts under 2020 conditions, and no additional mitigation is required.

Cumulative Evaluation of Impacts

Cumulative impacts on vegetation resources are analyzed in Chapter 10, "Cumulative Impacts." This chapter also summarizes the other foreseeable future projects that may contribute to these impacts.

Historically, the study area consisted of a mosaic of tidal marshland dominated by bulrushes with a few low natural levees that supported woody riparian vegetation, grassland, and upland shrubs (Thompson 1957). Today, agricultural land dominates the study area. Some small, apparently natural, islands remain as do some in-channel islands that are remnants of dredging and levee construction.

Levees in the south Delta typically have waterside slopes that are rock-lined or dominated by ruderal vegetation. Levees are actively maintained to control woody vegetation that could destabilize the levee structure. As a result, there is little or no native woody vegetation on the levees. Interior areas of most south Delta islands are actively farmed and contain little or no natural vegetation. Consequently, most remaining undisturbed native land cover types occur on in-channel islands or in small isolated patches along the waterside of the levees.

The study area includes all lands within the construction footprint of the gates, the channel dredging and gate dredging areas, and areas affected by operation of the gates within the study area (Figures 6.2-1 through 6.2-8). The study area land cover types can be divided into artificial and natural vegetation communities. Agriculture and landscaped and developed lands are artificial vegetation communities because they are maintained. The other vegetation communities and the aquatic communities are natural community types. Both the artificial and natural community types are addressed as NCCP communities in the MSCS (CALFED Bay-Delta Program 2000e). The mapped land cover types are described in Section 6.2, Vegetation and Wetlands. Table 6.3-1 includes a crosswalk between the CALFED NCCP communities, where applicable, and the land cover types identified in this document. Table 6.3-1 also includes the extent of each land cover type mapped by DWR as well as the affected area associated with each of the gates and the areas proposed for dredging.

Table 6.3-S. Summary of Significant Impacts and Mitigation Measures on Wildlife Resources for the South Delta Improvements Program

Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-2: Loss of Riparian-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-1: Replace Riparian Land Cover Types WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources.	Less than significant
WILD-3: Loss of Tidal Emergent Wetland–Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources. WILD-MM-4: Replace Wetland Land Cover Types	Less than significant
WILD-4: Loss of Tidal Perennial Aquatic–Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-3: Minimize Impacts on Sensitive Biological Resources. WILD-MM-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.	Less than significant
WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Potentially significant	No mitigation is required. WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources.	Less than significant
WILD-8: Loss of Valley Elderberry Longhorn Beetle or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-6: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs. WILD-MM-7: Avoid and Minimize Impacts on Elderberry Shrubs. WILD-MM-8: Compensate for Unavoidable Impacts on Elderberry Shrubs.	Less than significant

Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-9: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat as a Result of Gate Construction, Channel Dredging and Siphon Extensions.	2A–2C	Significant	WILD-MM-1: Replace Riparian Land Cover Types. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources. WILD-MM-9: Perform Preconstruction Surveys for Nesting Swainson's Hawks Prior to Construction and Maintenance. WILD–MM-10: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites. WILD-MM-11: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat. WILD-MM-12: Avoid Removal of Occupied Nest Sites.	Less than significant
WILD-9: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat as a Result of Gate Construction, Channel Dredging and Siphon Extensions.	3B, 4B	Significant	WILD-MM-1: Replace Riparian Land Cover Types. WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources. WILD-MM-9: Perform Preconstruction Surveys for Nesting Swainson's Hawks Prior to Construction and Maintenance. WILD–MM-10: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites. WILD-MM-11: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat. WILD-MM-12: Avoid Removal of Occupied Nest Sites.	

Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-10: Loss or Disturbance of San Joaquin Kit Fox or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-13: Perform Preconstruction Surveys for San Joaquin Kit Fox. WILD-MM-14: Minimize Construction-Related Disturbances near Active Den Sites. WILD-MM-15: Replace Lost San Joaquin Kit Fox Habitat.	Less than significant
WILD-11: Loss of Giant Garter Snake or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-4: Replace Wetland Land Cover Types. WILD-MM-16: Conduct Preconstruction Surveys for Giant Garter Snake. WILD-MM-17: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.	Less than significant
WILD-12: Loss of Western Pond Turtle or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-4: Replace Wetland Land Cover Types. WILD-MM-18: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.	Less than significant
WILD-13: Loss or Disturbance of Raptor Nest Sites as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources.	Less than significant

Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat as a Result of Gate Construction and Channel Dredging.	2A–2C, 3B, 4B	Significant	WILD-MM-1: Replace Riparian Land Cover Types. WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources. WILD-MM-4: Replace Wetland Land Cover Types. WILD-MM-19: Conduct Preconstruction Surveys for Tricolored Blackbird. WILD-MM-20: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies.	Less than significant
WILD-15: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources. WILD-MM-21: Conduct Preconstruction Surveys for Burrowing Owls. WILD-MM-22: Minimize Construction-Related Disturbances near Occupied Nest Sites. WILD-MM-23: Avoid or Minimize Disturbance to Active Nest and Roost Sites. WILD-MM-24: Mitigation of Impacts on Occupied Burrows. WILD-MM-25: Replace Lost Burrowing Owl Foraging Habitat.	Less than significant

Impact	Applicable Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-16: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions.	2A–2C, 3B, 4B	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-MM-3: Minimize Impacts on Sensitive Biological Resources. WILD-MM-4: Replace Wetland Land Cover Types. WILD-MM-26: Conduct Preconstruction Surveys for California Black Rail. WILD-MM-27: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.	Less than significant

Table 6.3-1. Crosswalk between Land Cover Types and Wildlife Habitats in the Study Area

Wildlife Habitats	Land Cover Types in the Study Area: Land Cover Type	Land Cover Types in the Study Area: Acres	Total Acres for Wildlife Habitat Association
Tidal perennial aquatic habitat	Tidal perennial aquatic	2,225.6	2,225.6
Tidal freshwater emergent marsh habitat	Tule and cattail tidal emergent wetland	121.2	121.2
Riparian woodland	Cottonwood-willow woodland	384.5	467.1
	Valley oak riparian woodland	82.6	
Riparian scrub	Riparian scrub	131.9	278.2
	Willow scrub	133.6	
	Giant reed stand	12.7	
Agricultural land	Agriculture (at gate sites only)	125.5	125.5
Developed lands	Developed land	6.8	7.2
	Landscaping	2.4	
Ruderal herbaceous	Ruderal	526.1	526.1

Sources of Information

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

- a review of the project alternatives;
- the wildlife resources sections of the CALFED Programmatic EIR/EIS, the ISDP EIR/EIS, and the CALFED MSCS;
- habitat mapping provided by DWR;
- field surveys performed by DWR;
- personal communications with DWR staff;
- a review of aerial photographs (September 2000);
- a review of the CNDDB (California Natural Diversity Database 2004); and
- a species list provided by USFWS for the SDIP, dated November 8, 2004 (Appendix M).

The CNDDB search included all USGS quadrangle maps in which the project area is located. The CNDDB search included the Woodward Island, Holt, CCF, Union Island, Lathrop, and Stockton West 7.5-minute quadrangles. The USFWS species list included special-status species that occur or may occur in Contra Costa and San Joaquin Counties (Appendix M).

Wildlife Habitat—Land Cover Type Associations in the Study Area

This section summarizes the land cover types identified in the study area and describes the conceptual relationship between land cover types and the wildlife habitats addressed in this analysis. Land cover types are described in Section 6.2, Vegetation and Wetlands. While land cover types emphasize floristic composition, structure, and other physical attributes, wildlife habitats additionally emphasize a land cover type's function and value for wildlife species. In some instances two or more land cover types may provide similar functions and values for wildlife (e.g., riparian scrub and willow scrub). Table 6.3-2 presents wildlife species and species groups whose habitat can be provided by each land cover type. Table 6.3-1 provides a crosswalk between the land cover types and wildlife habitat nomenclature for each cover type and identifies the acreage of each land cover type in the study area.

The following sections summarize the relationship between wildlife habitats and the associated land cover types within the project area that were identified in Section 6.2, Vegetation and Wetlands. Additionally, this section identifies the functions and values of each wildlife habitat, identifies associated common and special-status species wildlife species, and identifies supporting ecological processes in the project area. For the purpose of this analysis, the general wildlife groups identified in this section are composed of common wildlife species. Special-status species are discussed separately later in this section.

Seven general wildlife groups were identified for this analysis. Although other wildlife groups could be developed for the project area, the wildlife groups represent the most common and abundant species in the project area. The wildlife groups for this analysis include:

- waterfowl,
- shorebirds,
- water and wading birds,
- songbirds,
- raptors,
- mammals, and
- reptiles and amphibians.

Five natural land cover types and two artificial land cover types are present in the study area (Table 6.3-3). The natural land cover types are tidal perennial aquatic, tidal emergent wetland, riparian woodland, riparian scrub, and ruderal. The artificial land cover types are agricultural and developed lands. The following sections:

- describe the wildlife habitats and land cover types associated with each habitat type;

Table 6.3-2. Common Wildlife Species and Species Groups Associated with Land Cover Types

		Primary Habitat Functions and Representative Common Wildlife Species			
Land Cover Type	Associated Wildlife Groups	Breeding/Nesting	Foraging	Rearing	Roosting
Tidal perennial aquatic	Waterfowl	Common merganser Ruddy duck	Common merganser Ruddy duck	Common merganser Ruddy duck	Common merganser Ruddy duck
	Shorebirds	NA	Western sandpiper Killdeer Black-necked stilt	NA	NA
	Wading and water birds	NA	Great and snowy egret Green heron	NA	NA
	Raptors	NA	Northern harrier Peregrine falcon	NA	NA
	Songbirds	NA	Tree swallows Black phoebe	NA	NA
	Mammals	NA	Muskrat Raccoon	NA	NA
	Amphibians	Bullfrog	Bullfrog	Bullfrog	Bullfrog
	Reptiles	NA	Western garter snake	Western garter snake	Western garter snake
Tidal emergent wetland	Waterfowl	Mallard Ruddy duck	Mallard Ruddy duck	Mallard Ruddy duck	Mallard Ruddy duck
	Shorebirds	NA	NA	NA	NA
	Wading and water birds	NA	Great and snowy egret Green heron	NA	NA
	Raptors	NA	Northern harrier	NA	NA

		Primary Habitat Functions and Representative Common Wildlife Species			
Land Cover Type	Associated Wildlife Groups	Breeding/Nesting	Foraging	Rearing	Roosting
	Songbirds	Red-winged blackbird Marsh wren	Red-winged blackbird Marsh wren Tree swallows Black phoebe	Red-winged blackbird Marsh wren	Red-winged blackbird Marsh wren
	Mammals	Muskrat River otter	Muskrat Raccoon River otter	Muskrat River otter	Muskrat River otter
	Amphibians	Pacific chorus frog Bullfrog	Pacific chorus frog Bullfrog	Pacific chorus frog Bullfrog	Pacific chorus frog Bullfrog
	Reptiles	Western garter snake	Western garter snake	Western garter snake	Western garter snake
Valley foothill riparian (riparian woodland and/or riparian scrub)	Waterfowl	Wood duck	NA	NA	NA
	Shorebirds	NA	NA	NA	NA
	Wading and water birds	Great-blue heron Great and snowy egrets Black-crowned night herons	NA	NA	Great-blue heron Great and snowy egrets Black-crowned night herons
	Raptors	Red-tailed hawk Red-shoulder hawk Great-horned owl	Red-shouldered hawk	Red-tailed hawk Red-shoulder hawk Great-horned owl	Red-tailed hawk Red-shoulder hawk Great-horned owl

		Primary Habitat Functions and Representative Common Wildlife Species			
Land Cover Type	Associated Wildlife Groups	Breeding/Nesting	Foraging	Rearing	Roosting
	Songbirds	Tree swallows Black-headed grosbeak Spotted towhee Bullock's oriole Scrub jay	Tree swallows Black-headed grosbeak Spotted towhee Bullock's oriole Scrub jay Warblers Ash-throated flycatcher	Tree swallows Black-headed grosbeak Spotted towhee Bullock's oriole Scrub jay Ash-throated flycatcher	Tree swallows Black-headed grosbeak Spotted towhee Bullock's oriole Scrub jay Ash-throated flycatcher
	Mammals	Raccoon Western red bat Long-tailed weasel	Raccoon Western red bat Long-tailed weasel	Raccoon Western red bat Long-tailed weasel	Raccoon Western red bat California myotis
	Amphibians		Western toad Pacific chorus frog	Western toad Pacific chorus frog	Western toad Pacific chorus frog
Agricultural land (row crops and pasture land)	Waterfowl	Mallard	Mallard Greater white-fronted goose Snow goose	NA	Greater white-fronted goose Snow goose
	Shorebirds	Killdeer	Killdeer	Killdeer	Killdeer
	Wading and water birds	NA	Sandhill crane Great egret	NA	NA
	Raptors	Burrowing owl	Red-tailed hawk Northern harrier	Burrowing owl	Northern harrier Burrowing owl

		Primary Habitat Functions and Representative Common Wildlife Species			
Land Cover Type	Associated Wildlife Groups	Breeding/Nesting	Foraging	Rearing	Roosting
	Songbirds	Meadowlark Savannah sparrow	Meadowlark Brewer's blackbird	Meadowlark Savannah sparrow	Sparrows
	Mammals	Coyote California vole California ground squirrel	Coyote California vole California ground squirrel	Coyote California vole California ground squirrel	Coyote California vole California ground squirrel
	Amphibians	Western toad	Western toad	Western toad	Western toad California tiger salamander
	Reptiles	Gopher snake	Gopher snake	Gopher snake	Gopher snake
Ruderal land cover type	Waterfowl	Mallard (grasslands adjacent to wetlands)	NA	NA	NA
	Shorebirds	Killdeer	Killdeer	Killdeer	Killdeer
	Wading and water birds	NA	Sandhill crane Great egret	NA	NA
	Raptors	Northern harrier Short-eared owl Burrowing owl	Red-tailed hawk Northern harrier	Northern harrier Short-eared owl Burrowing owl	Northern harrier Short-eared owl Burrowing owl
	Songbirds	Meadowlark Savannah sparrow Horned lark	Meadowlark Savannah sparrow Brewer's blackbird	Meadowlark Savannah sparrow Horned lark	Meadowlark Sparrows Horned lark
	Mammals	Coyote California vole California ground squirrel	Coyote California vole California ground squirrel	Coyote California vole California ground squirrel	Coyote California vole California ground squirrel

		Primary Habitat Functions and Representative Common Wildlife Species			
Land Cover Type	Associated Wildlife Groups	Breeding/Nesting	Foraging	Rearing	Roosting
	Amphibians	Western toad	Western toad	Western toad	Western toad
	Reptiles	Gopher snake	Gopher snake	Gopher snake	Gopher snake
Tidal freshwater emergent	Waterfowl	Mallard Ruddy duck	Mallard Ruddy duck	Mallard Ruddy duck	Mallard Ruddy duck
	Shorebirds	NA	NA	NA	NA
	Wading and water birds	NA	Great and snowy egret Green heron	NA	NA
	Raptors	NA	Northern harrier	NA	NA
	Songbirds	Red-winged blackbird Marsh wren	Red-winged blackbird Marsh wren Tree swallows Black phoebe	Red-winged blackbird Marsh wren	Red-winged blackbird Marsh wren
	Mammals	Muskrat River otter	Muskrat Raccoon River otter	Muskrat River otter	Muskrat River otter
	Amphibians	Pacific chorus frog Bullfrog	Pacific chorus frog Bullfrog	Pacific chorus frog Bullfrog	Pacific chorus frog Bullfrog
	Reptiles	Western garter snake	Western garter snake	Western garter snake	Western garter snake

Table 6.3-3. Existing Land Cover Types in the SDIP Study Area and Project Area

NCCP Community Type	Land Cover Type	Total Acres in Study Area	Acreage at Gate Sites: Middle River Flow Control Gate	Acreage at Gate Sites: Grant Line Canal Flow Control Gate	Acreage at Gate Sites: Old River at DMC Flow Control Gate	Acreage at Gate Sites: Head of Old River Fish Control Gate	Acreage at Dredging Areas: West Canal Conveyance Dredging Area	Acreage at Dredging Areas: Middle River Conveyance Dredging Area	Acreage at Dredging Areas: Old River Conveyance Dredging Area	Acreage at Dredging Areas: Spot Dredging Areas for Agricultural Diversion	Acreage at Dredge Material Disposal Sites
Tidal perennial aquatic	Tidal perennial aquatic	2,225.6	8.3	10.4	3.7	7.6	73.0	72.7	123.5	477.3	0
Tidal freshwater emergent	Tule and cattail tidal emergent wetland	121.2	0.5	0.4	0.4	0	3.3	6.6	8.7	29.04	0
Valley/foothill riparian	Cottonwood-willow woodland (upland and wetland)	384.5	0.4	1.9	0	0	14.2	28.3	69.0	89.7	3.8
	Valley oak riparian woodland	82.6	0	0	0	0	0.1	14.7	23.5	34.5	0.8
	Riparian scrub (upland and wetland)	131.9	0.7	1.0	0.9	0	5.0	28.2	24.2	23.7	2.4
	Willow scrub (upland and wetland)	133.6	0	0.1	0.2	0	4.3	14.4	25.5	22.0	6.6
	Giant reed stand	12.7	0	0	0	0	0.4	0.1	3.7	3.7	0
Upland cropland	Agriculture	125.5	0.5 [1]	2.5 [1]	13.5 [1]	1.6 [1]	0	0	0	0	101.5
Not applicable	Developed land	6.8	– [1]	– [1]	– [1]	– [1]	0	0	0.5	3.5	0
Not applicable	Landscaping	2.4	0	0	0	0	0	0	0.1	1.9	0
Not applicable	Ruderal	526.1	0.2	1.0	0	3.2	29.5	122.7	78.29	77.6	47.4
	Total	**3,572.9**	**10.6**	**17.3**	**18.7**	**12.4**	**129.8**	**287.7**	**356.9**	**757.2**	**162.6**

Notes:

DMC = Delta-Mendota Canal.

[1] Agriculture acreages were planimetered from aerial photographs of the proposed dredge drying areas at the gate sites. Part of the agricultural land acreage included in the gate site dredge drying areas is ruderal vegetation, which has not yet been separately mapped in these areas. Developed land was not mapped at the gate sites.

- identify the functions and values of each land cover type;
- identify associated common wildlife species; and
- identify supporting processes in the project area.

Tidal Perennial Aquatic

The tidal perennial aquatic land cover type is present throughout the study area, including all gate and channel dredging areas (Figures 6.2-2 through 6.2-8). Tidal perennial aquatic habitat includes deepwater, shallow aquatic, and unvegetated intertidal areas within sloughs and channels.

Deepwater areas are largely unvegetated; however, beds of aquatic plants occasionally occur in shallower open-water areas. Deepwater areas provide foraging, roosting, and escape cover for a number of diving ducks, cormorants, grebes, and other waterfowl that are permanent residents or that winter in the project area (CALFED Bay Delta Program 2000b). Deepwater areas provide habitat for several reptiles and amphibians, including western pond turtles and western garter snake. Common mammal species in the deepwater areas include river otter, which use the deepwater areas for foraging and escape cover, and muskrats, which may use deepwater areas as migration corridors between suitable foraging areas.

Shallow aquatic areas may include shallow open-water areas or areas dominated by tidal perennial aquatic plant species, such as water hyacinth or water primrose. Colonies of these aquatic plants are generally infrequent but provide important habitat for a number of species. Shallow aquatic areas provide foraging habitat for diving and dabbling ducks, other waterfowl species, kingfishers, and wading birds. Shallow aquatic areas provide rearing, escape cover, and foraging for reptiles and amphibians and may be used as foraging habitat by river otter and raccoon.

Tidal flats provide important foraging habitat for migratory, resident, and wintering shorebirds, wading birds, and numerous other bird species. Tidal flats typically contain large concentrations of aquatic invertebrate and mollusks that serve as the primary food source of shorebirds.

Tidal Emergent Wetland

Wetlands are considered to be among the most productive wildlife habitats in California. Tule and cattail tidal emergent wetland, herein referred to as tidal emergent wetland, includes portions of the intertidal zones of the Delta that support emergent wetland plant species. Tidal emergent wetlands include all or portions of the tidal and Delta sloughs, and in-channel islands and shoals habitats. Tidal emergent wetland occurs along all channels and most in-channel islands in the study area, including the gate and dredge areas. This habitat typically occurs in small isolated patches or narrow discontinuous bands throughout the study area.

Although tidal emergent wetland does not occur in large continuous patches, this cover type provides important wildlife habitat functions and values. Tidal emergent wetland occurring on or adjacent to in-channel islands provides habitat that is relatively isolated from human disturbance and land-based predators. This land cover type provides nesting and foraging habitat for several songbirds, including red-winged blackbird, song sparrow, common yellowthroat, and marsh wren; provides foraging and nesting habitat for rails, other wading birds, and waterfowl; and provides foraging and cover habitat for common reptiles and amphibians, including western garter snake and bullfrogs.

Riparian Woodland

Riparian habitats are considered to be among the most productive wildlife habitats in California and typically support the most diverse wildlife communities. In addition to providing important nesting and foraging habitat, riparian woodlands function as wildlife movement corridors. Riparian habitat has been designated by DFG as a habitat of special concern in California because of its limited abundance and high value to wildlife.

Riparian woodlands occur throughout the study area, including the gate and dredge areas. Riparian woodlands in the study area are composed of the cottonwood willow riparian and valley oak riparian land cover types. Although the composition of dominant species differs between these two land cover types, the riparian tree species provide similar functions and values for wildlife. Although riparian woodlands in the study area typically occur in narrow or discontinuous patches, this cover type provides important function and values for wildlife. Riparian woodland habitat occurring on in-channel islands provides habitat that is relatively isolated from human disturbance and land-based predators. Also, aside from ornamental or landscape trees associated with farms or isolated trees in fields and along roadsides, riparian woodlands provide the only overstory and midstory vegetation. Overstory trees may be used for nesting and roosting by numerous raptors, including Swainson’s hawk, white-tailed kite, red-tailed hawk, barn owl, great horned owl, and kestrel. Overstory trees also provide suitable habitat for other birds—herons, egrets, and numerous songbirds, such as Bullock’s oriole and swallows. Riparian woodlands also provide important nesting and foraging cover for resident, migratory, and wintering songbirds. Riparian woodlands provide habitat for several species of mammals, including raccoon, Virginia opossum, and striped skunk. Riparian woodland provides cover and foraging habitat for reptiles and amphibians, such as western garter snake, bullfrogs, Pacific chorus frog, and western toad. Suitable areas in the understory may be used as nesting habitat for western pond turtles. Elderberry shrubs also may be associated with this community type.

Riparian Scrub

Riparian scrub occurs throughout the study area, including the gate and dredge areas. Riparian scrub is composed of three land cover types: riparian scrub, willow scrub, and stands of giant reed. Riparian scrub habitat provides functions and values for wildlife similar to riparian woodland; however, riparian scrub habitat lacks an overstory component. Although riparian scrub habitat typically occurs in narrow or discontinuous patches, this cover type provides important function and values for wildlife. Riparian scrub occurring on in-channel islands provides habitat that is relatively isolated from human disturbance and land-based predators. Elderberry shrubs also may be associated with this community type.

Ruderal Land Cover Type

The ruderal land cover type is dominated by herbaceous, nonnative, weedy species. Ruderal vegetation generally occurs in disturbed upland areas, on levee slopes and on the edges of agricultural fields and roads. Ruderal vegetation is typically most extensive on the landside levee faces at the gate sites and at the proposed dredge spoils basins along Middle River. Ruderal vegetation also occurs on the waterside of the levees; however, in these locations it is typically interspersed with riparian woodland and scrub. The ruderal cover type provides nesting and foraging habitat for several species of resident and wintering songbirds, including savanna sparrow and white-crowned sparrow. The ruderal land cover type provides foraging and haul-out areas for several aquatic wildlife species and potential nesting habitat for western pond turtles.

Agricultural Land Cover Type

Agriculture lands, as defined for this analysis, include agricultural lands that are not seasonally flooded. Major crops and cover types in agricultural production include small grains, field crops, truck crops, forage crops, pastures, orchards, and vineyards. The distribution of seasonal crops varies annually, depending on crop-rotation patterns and market forces. Agricultural lands are present in lands adjacent to the channel dredging areas and would be used to house temporary settling basins for dredging operations. Agricultural lands adjacent to the gate sites include row and pasture crops. In areas not intensively cultivated, such as fallow fields, roads, ditches, and levee slopes, regular maintenance precludes the establishment of ruderal vegetation or native vegetation communities.

Agricultural irrigation ditches are part of most of the agricultural fields in the south Delta. Because the habitat provided by agricultural ditches is different from that of agricultural fields, it is described separately. Ditches are present throughout much of the project area on the landside of the levees, but because avoidance of these features is assumed for most project activities, they were mapped only within the proposed dredged material disposal sites on Roberts Island. Ditches are either cement-lined or earth-lined.

Earth-lined agricultural ditches in the project area typically are installed, removed, and maintained periodically as part of routine farming practices. Most of these ditches are shallow and do not intersect the water table. These ditches are generally saturated or ponded for long durations; however, the water is pumped on and off as needed as part of routine farming operations (irrigation). Because water is present for long duration, ditches may exhibit wetland characteristics. Because these features have been excavated and are generally subject to maintenance, they have minimal suitable habitat for wildlife.

Agricultural lands provide foraging areas for many species that occur in the study area. The forage value for species varies seasonally and annually, depending on the crop cycle and on the vegetative cover present at the site. Agricultural and adjacent lands provide foraging areas for several bird species, including resident and wintering raptors, songbirds, shorebirds, and wading birds. Agricultural lands also provide foraging areas for small rodents, coyote, raccoon, opossum, and gopher snakes.

Developed Lands

Developed lands mapped in the study area include areas with roads, buildings, and landscapes but also include barren areas that have been disturbed and are unvegetated. Barren areas occur along riprapped levee faces and at the tops of levees. Developed land is mapped at all of the proposed gate sites and at the head of Old River fish control gate site. A minimal amount of this cover type occurs in the project area on the south bank of Old River west of the Old River gate site. Because of the disturbance related to installation of landscaping and the ongoing maintenance, these areas provide minimal value to wildlife in the study area.

Regulatory Setting

This section provides preliminary information on the major requirements for permitting and environmental review and consultation related to wildlife resources for implementation of the SDIP. Certain state and federal regulations require issuance of permits before project implementation; other regulations require agency consultation but may not require issuance of any entitlements before project implementation. The SDIP's requirements for permits and environmental review and consultation may change during the EIS/EIR review process as discussions with involved agencies proceed.

Federal Requirements

Federal Endangered Species Act

Section 7 of the ESA requires federal agencies, in consultation with USFWS and/or NOAA Fisheries, to ensure that their actions do not jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of these species. The required steps in the Section 7 consultation process are as follows:

- Agencies must request information from USFWS and/or NOAA Fisheries on the existence in a project area of special-status species or species proposed for listing.
- Following receipt of the USFWS/NOAA Fisheries response to this request, agencies generally prepare a BA to determine whether any special-status species or species proposed for listing are likely to be affected by a proposed action.
- Agencies must initiate formal consultation with USFWS and/or NOAA Fisheries if the proposed action would/may adversely affect special-status species.
- USFWS and/or NOAA Fisheries must prepare a BO to determine whether the action would jeopardize the continued existence of special-status species or adversely modify their critical habitat.
- If a finding of jeopardy or adverse modifications is made in the BO, USFWS and/or NOAA Fisheries must recommend reasonable and prudent alternatives that would avoid jeopardy, and the federal agency must modify project approval to ensure that special-status species are not jeopardized and that their critical habitat is not adversely modified (unless an exemption from this requirement is granted).

In the preparation of the SDIP EIS/EIR, the MSCS approach was used and an ASIP, serving as the equivalent to the CALFED Programmatic SDIP BA, has been prepared in compliance with Section 7 of the ESA (SDIP ASIP).

State Requirements

California Endangered Species Act

The CESA requires a state lead agency to consult formally with DFG when a proposed action may affect state-listed endangered or threatened species. The provisions of ESA and CESA often will be activated simultaneously. The assessment of project effects on species listed under both ESA and CESA is addressed in USFWS's and NOAA Fisheries' BOs. However, for those species listed only under CESA, DWR must formally consult with DFG. DFG will ensure that the project complies with the provisions of CESA.

Special-Status Species

Special-status wildlife species are defined as animals that are legally protected under ESA, CESA, or other regulations and species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status wildlife include species that 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 concern that have the potential to occur in the project area because suitable or marginal habitat may exist for those species, as identified in the species list provided by Appendix M); species of special concern to the DFG and Special Animals list (California Department of Fish and Game 2001) (mammals) that have the potential to occur in the project 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 a review of the CNDDB (Table 6.3-4). Those species that are likely to occur in the study area are further evaluated in this section (Table 6.3-5)

Assessment Methods

This evaluation of impacts on special-status wildlife resources and wildlife habitat was based on:

- an analysis of the project alternatives,
- a review of available data and reports from other surveys performed in the study area,
- habitat mapping provided by DWR; and
- field surveys and literature reviews performed by DWR.

Specific information pertaining to field surveys and literature reviews performed and provided by DWR is provided in the following species accounts.

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Mammals					
Berkeley kangaroo rat *Dipodomys heermanni berkeleyensis*	SC/–	Alameda and Contra Costa Counties.	Open grassy hilltops and open spaces in chaparral and blue oak/foothill pine woodlands. Needs fine, deep well-drained soil for burrowing.	No suitable habitat in the project area.	No
Fringed myotis *Myotis thysanodes*	SC/–	Occurs throughout California except the southeastern deserts and the Central Valley.	Found in a wide variety of habitats, from low desert scrub to high elevation coniferous forests. Day and night roosts in caves, mines, trees, buildings, and rock crevices.	Outside the species known range.	No
Greater western mastiff-bat *Eumops perotis californicus*	SC/CSC	Occurs along the western Sierra primarily at low to mid elevations and widely distributed throughout the southern coast ranges. Surveys have detected the species north to the Oregon border.	Found in a wide variety of habitats from desert scrub to montane conifer. Roosts and breeds in deep, narrow rock crevices, but may also use crevices in trees, buildings, and tunnels.	No suitable habitat in the project area.	No
Long-legged myotis *Myotis volans*	SC/–	Mountains throughout California, including ranges in the Mojave desert.	Most common in woodlands and forests above 4,000 feet, but occurs from sea level to 11,000 feet.	No suitable habitat in the project area.	No
Merced kangaroo rat *Dipodomys heermanni dixoni*	SC/–	Foothills of the Sierra Nevada from Fresno to El Dorado Counties, the Coast Ranges from San Francisco Bay to Point Conception and the San Joaquin Valley.	Occurs in annual grassland, coastal sage scrub, mixed and montane chaparral, and early successional valley foothill hardwood and hardwood-conifer habitats.	No suitable habitat in the project area.	No
Pacific western big-eared bat *Plecotus townsendii pallescens*	SC/CSC	Coastal regions from Del Norte County south to Santa Barbara County.	Roosts in caves, tunnels, mines, and dark attics of abandoned buildings. Very sensitive to disturbances and may abandon a roost after one onsite visit.	Outside the species known range.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
San Joaquin Valley woodrat *Neotoma fuscipes riparia*	E/CSC	Historical distribution along the San Joaquin, Stanislaus, and Tuolumne Rivers, and Caswell State Park in San Joaquin, Stanislaus, and Merced Counties; presently limited to San Joaquin County at Caswell State Park and a possible second population near Vernalis.	Riparian habitats with dense shrub cover, willow thickets, and an oak overstory.	Outside the species known range.	No
Salt marsh harvest mouse *Reithrodontomys raviventris*	E/CE, FP	San Francisco, San Pablo, and Suisun Bays; the Delta.	Salt marshes with a dense plant cover of pickle-weed and fat hen; adjacent to an upland site.	Outside the species known range. No suitable habitat in the project area.	No
Salt marsh vagrant shrew *Sorex vagrans halicoetes*	SC/–	Restricted to southern and northwestern San Francisco Bay.	Midelevation salt marsh habitats with dense growths of pickleweed; requires driftwood and other objects for nesting cover.	Outside the species known range. No suitable habitat in the project area.	No
Riparian brush rabbit *Sylvilagus bachmani riparius*	E/CE	Limited to San Joaquin County at Caswell State Park near the confluence of the Stanislaus and San Joaquin Rivers and Paradise Cut area on Union Pacific right-of-way lands.	Native valley riparian habitats with large clumps of dense shrubs, low-growing vines, and some tall shrubs and trees.	Outside the species known range.	No
San Francisco dusky-footed woodrat *Neotoma fuscipes annectens*	SC/–	West side of Mount Diablo to coast and San Francisco Bay.	Present in chaparral habitat and in forest habitats with a moderate understory.	Outside the species known range.	No
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.	This species is not found in the Delta; however the project area is in or near the species range.	Yes
San Joaquin pocket mouse *Perognathus inornatus*	SC/–	Occurs throughout the San Joaquin Valley and in the Salinas Valley.	Favors grasslands and scrub habitats with fine textured soils.	Potential suitable habitat in portions of the project area.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Small-footed myotis *Myotis ciliolabrum*	SC/–	Occurs in the Sierra Nevada, south Coast, Transverse, and Peninsular Ranges, and in the Great Basin.	Open stands in forests and woodlands, as well as shrub lands and desert scrub. Uses caves, crevices, trees, and abandoned buildings.	No suitable habitat in the project area.	No
Suisun ornate shrew *Sorex ornatus sinuosus*	SC/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.	Outside the species known range. No suitable habitat in the project area.	No
Yuma myotis *Myotis yumanensis*	SC/–	Common and widespread throughout most of California except the Colorado and Mojave deserts near water bodies.	Found in a wide variety of habitats from sea level to 11,000 feet, but uncommon above 8,000 feet. Optimal habitat is open forests and woodlands.	No suitable habitat in the project area.	No
Birds					
Alameda song sparrow *Melospiza melodia pusillula*	SC/CSC	Found only in marshes along the southern portion of the San Francisco Bay.	Brackish marshes associated with pickleweed; may nest in tall vegetation or among the pickleweed.	Outside the species known range.	No
Allen's hummingbird *Selasphorus sasin*	SC/–	Summer resident along most of the California coast.	Most commonly breeds in coastal scrub, valley foothill hardwoods and valley foothill riparian but may also occur in association with redwood and closed-cone pine habitats and urban areas.	May occur in the project area during migration.	No
American bittern *Botaururs lentiginosus*	SC/–	Widespread in suitable habitats in winter. Breeds locally in the Central Valley, the northeast plateau, the Imperial Valley and the coastal slope south of Monterey.	Occurs in tall, dense stands of emergent wetland vegetation.	Marginal habitat present in the project area.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Aleutian Canada goose *Branta canadensis leucopareia*	SC/–	The entire population winters in Butte Sink, then moves to Los Banos, Modesto, the Delta, and East Bay reservoirs; stages near Crescent City during spring before migrating to breeding grounds.	Roosts in large marshes, flooded fields, stock ponds, and reservoirs; forages in pastures, meadows, and harvested grainfields; corn is especially preferred.	Winter resident in the project area. Suitable foraging habitat present in the project area.	No
American peregrine falcon *Falco peregrinus anatum*	D/CE, FP	Permanent resident along the north and south Coast Ranges. May summer in the Cascade and Klamath Ranges and through the Sierra Nevada to Madera County. Winters in the Central Valley south through the Transverse and Peninsular Ranges and the plains east of the Cascade Range.	Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large prey populations.	May occur in the project area during migration or winter.	No
Bald eagle *Haliaeetus leucocephalus*	T, PR/CE, FP	Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin. Reintroduced into central coast. Winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierra Nevada, and east of the Sierra Nevada south of Mono County.	In western North America, nests and roosts in coniferous forests within 1 mile of a lake, reservoir, stream, or the ocean.	May occur in the project area during migration or winter.	No
Bank swallow *Riparia riparia*	SC/CT	Occurs along the Sacramento River from Tahama County to Sacramento County, along the Feather and lower American Rivers, in the Owens Valley; and in the plains east of the Cascade Range in Modoc, Lassen, and northern Siskiyou Counties. Small populations near the coast from San Francisco County to Monterey County.	Nests in bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam.	Outside of the species known range. No suitable habitat in the project area.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Bell's sage sparrow *Amphispiza belli belli*	SC/CSC	Western Sierra foothills from El Dorado County south to Mariposa County, inner Coast Ranges from Shasta County southward, extending to vicinity of coast from Marin County to San Diego County; from southern San Benito County to San Bernardino County.	Prefers chaparral habitats dominated by chamise.	Outside the species known range.	No
Black tern *Chlidonias niger*	SC/CSC	Spring and summer resident of the Central Valley, Salton Sea, and northeastern California where suitable emergent wetlands occur.	Freshwater wetlands, lakes, ponds, moist grasslands, and agricultural fields; feeds mainly on fish and invertebrates while hovering over water.	Suitable habitat present in the project area.	No
California black rail *Laterallus jamaicensis coturniculus*	SC/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 pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations.	Suitable habitat present in the project 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.	Outside the species known range. No suitable habitat in the project area.	No
California clapper rail *Rallus longirostris obsoletus*	E/CE, FP	Marshes around the San Francisco Bay and east through the Delta to 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.	Outside the species known range. No suitable habitat in the project area.	No
California horned lark *Eremophila alpestris actia*	–/CSC	Found throughout much of the state, less common in mountainous areas of the north coast and in coniferous or chaparral habitats.	Common to abundant resident in a variety of open habitats, usually where large trees and shrubs are absent. Grasslands and deserts to dwarf shrub habitats above tree line.	Suitable habitat present in the project area.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
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 occa-sionally uses mudflats; forages on adjacent surf line, estuaries, or the open ocean.	Outside the species known range. No suitable habitat in the project area.	No
California thrasher *Toxostoma redivivum*	SC/–	Common resident in foothills and lowlands in Cismontane California.	Occurs in dense chaparral habitats and occasionally in thickets of valley foothill riparian habitat.	Outside the species known range. No suitable habitat in the project area.	No
Common loon *Gavia immer*	SC/–	Primarily a winter visitor to California, but an occasional year-round resident; found along the entire coast and large inland bodies of water; formerly nested in northeastern California.	Nearshore coastal waters and bays; less common at large inland bodies of deep water with productive fisheries.	Occasional winter resident in the project area.	No
Cooper's hawk *Accipiter cooperii*	SC/–	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.	Suitable habitat present in the project area.	Yes
Costa's hummingbird *Calypte costae*	SC/–	Most common and widespread in southern California. Breeds locally along the western edge of the San Joaquin Valley north to Santa Clara County and on the east side of the Sierra Nevada in Inyo County.	Occurs in arid habitats including desert washes, desert and valley foothill riparian, chaparral, desert scrub and coastal scrub.	May occur in the project area during migration.	No
Ferruginous hawk *Buteo regalis*	SC/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 project area.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Grasshopper sparrow *Ammodramus savannarum*	SC/–	Uncommon summer resident in foothills and lowlands from Mendocino and Trinity Counties south to San Diego County.	Occurs in dense, dry grasslands with scatter small shrubs.	Outside the species known range. No suitable habitat in the project area.	No
Great blue heron (rookery) *Ardea herodias*	SB/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.	Suitable rookery sites present in the project area.	No
Greater sandhill crane *Grus canadensis tabida*	SC/CT, FP	Breeds in Siskiyou, Modoc, Lassen, Plumas, and Sierra Counties. Winters in the Central Valley, southern Imperial County, Lake Havasu National Wildlife Refuge, and the Colorado River Indian Reserve.	Summers in open terrain near shallow lakes or freshwater marshes. Winters in plains and valleys near bodies of fresh water.	Suitable foraging habitat is present in the project area.	Yes
Hermit warbler *Dendroica occidentalis*	SC/–	Summer resident in major mountain ranges in California, excluding Coastal Ranges south of Santa Cruz County. Rare winter resident.	Occurs in mature coniferous and montane hardwood-conifer habitat. During migration this species may occur in valley foothill hardwood and planted pine stands.	May occur in the project area during migration.	No
Lawrence's goldfinch *Carduelis lawrencei*	SC/–	Erratic and localized in occurrence in foothills surrounding the Central Valley, Santa Clara County, coastal slope south of Monterey County, and along the western edge of the southern California deserts.	Occurs in open oak and other arid woodland and chaparral habitats near water.	May occur in the project area during migration.	No
Lewis' woodpecker *Melanerpes lewis*	SC/–	Breeds locally on eastern slopes of the Coast Ranges and in the Sierra Nevada, Cascade Range, and Klamath an d Warner Mountains. Uncommon winter resident in the Central Valley.	Occurs in open oak savanna, deciduous, and coniferous habitats.	May occur in the project area during migration.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Little willow flycatcher *Empidonax traillii brewsteri*	SC/CE	Summers along the western Sierra Nevada from El Dorado to Madera County, in the Cascade and northern Sierra Nevada in Trinity, Shasta, Tahama, Butte, and Plumas Counties, and along the eastern Sierra Nevada from Lassen to Inyo County.	Riparian areas and large wet meadows with abundant willows. Usually found in riparian habitats during migration.	No suitable breeding habitat in the project area. May occur in the project area during migration.	No
Loggerhead shrike *Lanius ludovicianus*	SC/CSC	Resident and winter visitor in lowlands and foothills throughout California. Rare on coastal slope north of Mendocino County, occurring only in winter.	Prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches.	Suitable habitat present in the project area	No
Long-billed curlew *Numenius americanus*	SC/CSC	Nests in northeastern California in Modoc, Siskiyou, and Lassen Counties. Winters along the coast and in interior valleys west of Sierra Nevada.	Nests in high-elevation grasslands adjacent to lakes or marshes. During migration and in winter; frequents coastal beaches and mudflats and interior grasslands and agricultural fields.	May occur in the project area during migration.	No
Mountain plover *Charadrius montanu*	SC/CSC	Does not breed in California; in winter, found in the Central Valley south of Yuba County, along the coast in parts of San Luis Obispo, Santa Barbara, Ventura, and San Diego Counties; parts of Imperial, Riverside, Kern, and Los Angeles Counties.	Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grainfields.	Winter resident. May forage in agricultural lands.	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 project area.	Yes
Nuttall's woodpecker *Picoides nuttallii*	SLC/–	Occurs throughout the Central Valley, the Coast, Transverse, and Peninsular Ranges, and in lower elevations in the Cascade and Sierra Nevada Ranges.	Occurs primarily in oak and riparian habitats and urban areas with suitable foraging and nesting habitat.	Suitable habitat present in the project area.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Oak titmouse *Baeolophus inornatus*	SLC/–	Occurs in Cismontane California from the Mexican border to Humboldt County.	Occurs in riparian, montane hardwood, valley foothill hardwood/conifer habitats.	No suitable habitat in the project area.	No
Olive-sided flycatcher *Contopus cooperi*	SC/–	Summer resident in forests and woodland below 9,000 feet, excluding the Central Valley, deserts and other lowland areas. Uncommon transient in lowland areas.	Nests in mixed conifer, montane hardwood-conifer, redwood, Douglas-fir and other coniferous forest cover types.	May occur in the project area during migration.	No
Rufous hummingbird *Selasphorus rufus*	SC/–	Uncommon summer resident in California and a common summer resident in Oregon and Washington. In California this species breeds in the Trinity Mountains of Trinity and Humboldt Counties.	Occurs in a variety of habitats including valley foothill hardwood, riparian, mixed hardwood/pine, chaparral and mountain meadows.	May occur in the project area during migration.	No
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	SC/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.	Outside the species known range.	No
San Pablo song sparrow *Melospiza melodia samuelis*	SC/CSC	Found in San Pablo Bay.	Uses tidal sloughs within pickleweed marshes; requires tall bushes (usually grindelia) along sloughs for cover, nesting, and songposts; forages over mudbanks and in the pickleweed.	Outside the species known range.	No
Short-eared owl *Asio flammeus*	SC/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.	Suitable habitat present in the project area.	Yes

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Snowy egret (rookery) *Egretta thula*	SB/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.	No known rookery sites in the project area.	No
Suisun song sparrow *Melospiza melodia maxillaris*	SC/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.	Outside the species known range.	No
Swainson's hawk *Buteo swainsoni*	SC/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.	Suitable habitat present in the project area.	Yes
Tricolored blackbird *Agelaius tricolor*	SC/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.	Suitable habitat present in the project	Yes
Vaux's swift *Chaetura vauxi*	SC/–	Coastal belt from Del Norte County south to Santa Cruz County and in mid elevation forests of the Sierra Nevada and Cascade Range.	Nests in hollow, burned-out tree trunks in large conifers.	May occur in the project area during migration.	No
Western burrowing owl *Athene cunicularia hypugea*	SC/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 known to occur in the project area.	Yes

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Western snowy plover *Charadrius alexandrinus nivosus*	T/CSC	Nests at inland lakes throughout northeastern, central, and southern California, including Mono Lake and Salton Sea.	Barren to sparsely vegetated ground at alkaline or saline lakes, reservoirs, ponds and riverine sand bars; also along sewage, salt-evaporation, and agricultural wastewater ponds.	Suitable habitat present in the project area.	No
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	–/CE	Nests along the upper Sacramento, lower Feather, south fork of the Kern, Amargosa, Santa Ana, and Colorado Rivers.	Wide, dense riparian forests with a thick understory of willows for nesting; sites with a dominant cottonwood overstory are preferred for foraging; may avoid valley-oak riparian habitats where scrub jays are abundant.	No suitable habitat in the project area.	No
White-faced ibis *Plegadis chihi*	SC/CSC	Both resident and winter populations on the Salton Sea and in isolated areas in Imperial, San Diego, Ventura, and Fresno Counties; breeds at Honey Lake, Lassen County, at Mendota Wildlife Management Area, Fresno County, and near Woodland, Yolo County.	Prefers freshwater marshes with tules, cattails, and rushes, but may nest in trees and forage in flooded agricultural fields, especially flooded rice fields.	May occur during migration or as a winter resident.	No
White-tailed kite *Elanus leucurus*	SC/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.	Species known to occur in the project 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] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
California horned lizard *Phrynosoma coronatum frontale*	SC/CSC	Found throughout much of the state, less common in mountainous areas of the north coast and in coniferous or chaparral habitats.	Common to abundant resident in a variety of open habitats, usually where large trees and shrubs are absent. Grasslands and deserts to dwarf shrub habitats above tree line.	No suitable habitat in the project area.	No
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.	Potential habitat present in the project area.	Yes
San Joaquin coachwhip *Masticophis flagellum ruddocki*	SC/–	From Colusa county in the Sacramento Valley southward to the grapevine in the San Joaquin Valley and westward into the inner coast ranges. An isolated population occurs at Sutter Buttes. Known elevational range from 20 to 900 meters.	Occurs in open, dry, vegetative associations with little or no tree cover. It occurs in valley grassland and saltbush scrub associations. Often occurs in association with mammal burrows.	Marginal habitat present in the project area.	No
Silvery legless lizard *Anniella pulchra pulchra*	SC/CSC	Along the Coast, Transverse, and Peninsular Ranges from Contra Costa County to San Diego County with spotty occurrences in the San Joaquin Valley.	Habitats with loose soil for burrowing or thick duff or leaf litter; often forages in leaf litter at plant bases; may be found on beaches, sandy washes, and in woodland, chaparral, and riparian areas.	No suitable habitat in the project area.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Western pond turtle *Clemmys marmorata*	SC/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 known to occur in the project 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.	Outside the species known range. No suitable habitat in the project area.	No
California tiger salamander *Ambystoma californiense*	CS/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 project area.	No
Foothill yellow-legged frog *Rana boylii*	SC/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.	Outside the species known range.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Western spadefoot *Scaphiopus hammondii*	SC/CSC	Sierra Nevada foothills, Central Valley, Coast Ranges, coastal counties in southern California.	Shallow streams with riffles and seasonal wetlands, such as vernal pools in annual grasslands and oak woodlands.	No suitable habitat in the project area.	No
Invertebrates					
Antioch Dunes anthicid beetle *Anthicus anthiochensis*	SC/–	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 project area.	No
California linderiella *Linderiella occidentalis*	SC/–			No suitable habitat in the project 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 pendunculata*) grows; larvae feed on Johnny jump-up plants, whereas adults feed on native mints and non-native thistles.	No suitable habitat in the project area.	No
Ciervo aegialian scarab beetle *Aegialia concinna*	SC/–	Four locations known from Contra Costa, San Benito, Fresno, and San Joaquin Counties.	Sand dunes and sandy substrates.	No suitable habitat in the project 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.	No suitable habitat in the project area.	No
Curved-foot hygrotus diving beetle *Hygrotus curvipes*	SC/–	Kellogg Creek watershed and one site near Oakley, Contra Costa County and Alameda County.	Aquatic; Small seasonal pools and wetlands and small pools left in dry creek beds, associated with alkaline-tolerant vegetation.	No suitable habitat in the project area.	No
Longhorn fairy shrimp *Branchinecta longiantenna*	E/–	Eastern margin of central Coast Ranges from Contra Costa County to San Luis Obispo County; disjunct population in Madera County.	Small, clear pools in sandstone rock outcrops of clear to moderately turbid clay- or grass-bottomed pools.	No suitable habitat in the project area.	No

Species Name	Status[1] Federal/State	Distribution	Habitat	Likelihood of Occurrence in the Project Area	Proposed for Evaluation in the EIR
Mid-valley fairy shrimp *Brachinecta n.* sp. *Amid-valley*	SC/–			No suitable habitat in the project area.	No
Moestan blister beetle *Lytta moesta*	SC/–	Most records from San Joaquin Valley (Kern, Tulare, San Joaquin, and Stanislaus Counties); a few specimens collected from Santa Cruz County.	Feeds on flowers in the summer and fall, mostly composites.	No suitable habitat in the project area.	No
Sacramento anthicid beetle *Anthicus sacramento*	SC/–	Dune areas at mouth of Sacramento River; western tip of Grand Island, Sacramento County; upper Putah Creek and dunes near Rio Vista, Solano County; Ord Ferry Bridge, Butte County.	Found in sand slip-faces among willows; associated with riparian and other aquatic habitats.	No suitable habitat in the project area.	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.	Within the species known range. Suitable habitat may be present in the project area.	Yes
Valley elderberry longhorn beetle critical habitat *Desmocerus californicus dimorphus critical habitat*				Project area is not within the area designated as critical habitat.	No
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.	No suitable habitat in the project area.	No
Vernal pool tadpole shrimp *Lepidurus packardi*	E/–	Shasta County south to Merced County.	Vernal pools and ephemeral stock ponds.	No suitable habitat in the project area.	No
Yellow-banded andrenid bee *Perdita hirticeps luteocincta*	SC/–	Antioch Dunes, Contra Costa County.	Sand dunes.	No suitable habitat in the project area.	No

Notes:

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.
PE	=	Proposed for listing as endangered under ESA.
PT	=	Proposed for listing as threatened under ESA.
C	=	Candidate for listing under ESA.
SC	=	Species of concern under ESA.
SLC	=	Species of local concern under ESA.
D	=	Delisted. Status to be monitored for 5 years.
PR	=	Protected under the Bald and Golden Eagle Protection Act.
–	=	No federal status.

State

CE	=	Listed as endangered under the California Endangered Species Act (CESA).
CT	=	Listed as threatened under CESA.
CCE	=	Candidate for listing as endangered under CESA.
CCT	=	Candidate for listing as threatened under CESA.
R	=	Listed as rare under California Native Plant Protection Act.
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.

Table 6.3-5. Special-Status Species Likely to Occur in the Project Area

Species Name	Status[1] Federal	Status[1] State	Distribution	Habitat	Likelihood of Occurrence in Study Area
Mammals					
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 north to Contra Costa County.	Saltbush scrub, grassland, oak, savanna, and freshwater scrub.	Suitable habitat present in the portions of the project area.
Birds					
California black rail *Laterallus jamaicensis coturniculus*	SC	CT/FP	Permanent resident in the San Francisco Bay and eastward through the Delta into Sacramento and San Joaquin Counties; small populations in Marin, Santa Cruz, San Luis Obispo, Orange, Riverside, and Imperial Counties.	Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations.	Suitable habitat present in the project area.
Cooper's hawk *Accipiter cooperii*	SC	–	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.	Suitable habitat present in the project area.
Greater sandhill crane *Grus canadensis tabida*	SC	CT/FP	Breeds in Siskiyou, Modoc, Lassen, Plumas, and Sierra Counties. Winters in the Central Valley, southern Imperial County, Lake Havasu National Wildlife Refuge, and the Colorado River Indian Reserve.	Summers in open terrain near shallow lakes or freshwater marshes. Winters in plains and valleys near bodies of fresh water.	Suitable foraging habitat is present in the study area.
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.
Short-eared owl *Asio flammeus*	SC	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.	Suitable habitat present in the project area.
Swainson's hawk *Buteo swainsoni*	SC	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 known to occur in the study area.

Species Name	Status[1] Federal	State	Distribution	Habitat	Likelihood of Occurrence in Study Area
Tricolored blackbird *Agelaius tricolor*	SC	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.	Suitable habitat present in the study.
Western burrowing owl *Athene cunicularia hypugea*	SC	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.	Suitable habitat present in the study area.
White-tailed kite *Elanus leucurus*	SC	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.	Species known to occur in the study area.
Reptiles					
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.	Marginal habitat in the study area.
Western pond turtle *Clemmys marmorata*	SC	CSC	The northern 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.	The northern subspecies 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.	Species known to occur in the study area.
			The southern 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.	The southern subspecies occurs in 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 known to occur in the study area.

Species Name	Status[1] Federal	State	Distribution	Habitat	Likelihood of Occurrence in Study Area
Invertebrates					
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	–	Stream side habitats below 3,000 feet throughout the Central Valley.	Riparian and oak savanna habitats with elderberry shrubs; elderberries are the host plant.	Suitable habitat is present in the study area.

Notes:

Species listed in table are generated from the U.S. Fish and Wildlife Service (USFWS) study 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.

PE = Proposed for listing as endangered under ESA.

PT = Proposed for listing as threatened under ESA.

C = Candidate for listing under ESA.

SC = Species of concern under ESA.

SLC = Species of local concern under ESA.

D = Delisted. Status to be monitored for 5 years.

PR = Protected under the Bald and Golden Eagle Protection Act.

– = No federal or state status

State

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

CT = Listed as threatened under CESA.

CCE = Candidate for listing as endangered under CESA.

CCT = Candidate for listing as threatened under CESA.

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

CSC = California species of special concern.

FP = Fully protected under California Fish and Game Code.

SB = Specified birds under California Fish and Game Code.

Special-Status Species in the Project Area

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

- habitat requirements;
- suitable land cover types—wildlife habitats available for each species in the project area;
- surveys performed for the species in the study and project area; and
- the status of each species in the project area.

The special-status species listed in Table 6.3-4 were identified by USFWS and DFG as having the potential to occur in the project area. The special-status species listed in Table 6.3-5 includes 13 species that are likely to occur or have been observed in the project area. Several of these species are known to occur in the project area. The other species are not known to occur in the project area, but they occur or historically have occurred in the study area, and the project area contains breeding or nonbreeding habitat for these species.

The 13 species with potential to occur in the study area include:

- San Joaquin kit fox,
- California black rail,
- Cooper's hawk,
- greater sandhill crane,
- northern harrier,
- Swainson's hawk,
- short-eared owl,
- tricolored blackbird,
- western burrowing owl,
- white-tailed kite,
- giant garter snake,
- western pond turtle, and
- valley elderberry longhorn beetle (VELB).

San Joaquin Kit Fox

San Joaquin kit fox occur in open, arid habitats, including alkali desert scrub, grassland, and valley foothill hardwood habitats (U.S. Fish and Wildlife Service 1983). The kit fox requires large expanses of habitat and has a home range of approximately 1 to 2 square miles (Zeiner et al. 1990a). The portion of the study area west and south of Old River provides denning and foraging habitat for kit fox. The lack of migration corridors from suitable habitats makes it unlikely that this species would move into the remainder of the SDIP area north of Old River from the known breeding locations south of CCF.

There are approximately 1,142 acres of ruderal habitat and 13,100 acres of agricultural lands south and west of Old River that could provide foraging habitat for kit fox. Ruderal habitat could also provide denning areas. The ruderal habitats in the project area are linear in nature, are restricted to the levee banks and in-channel islands, and are often dominated by nonnative broadleaf weeds. Ruderal habitat provides low-quality denning and foraging habitat for kit fox. Agricultural lands south of Old River include primarily pastureland and row crops that would provide low-quality foraging habitat for kit fox.

The range of this species does not include most of the Delta; however, Byron Tract and the Old River flow control gate are in or near the species range. There is one USFWS sighting of a kit fox on the levee near the Old River gate site. A CNDDB records search identified five occurrences in the study area. All of these records occurred south of CCF (California Natural Diversity Database 2004). Two of these occurrences were within 2 miles of the proposed Old River gate. There is one record of kit fox (1991) from the south side of Old River approximately 1.5 miles south of the proposed gate. The other nearby occurrence (1992) was from the east side of the DMC approximately 2 miles from the Old River gate site.

No signs of recent kit fox activity were observed during preconstruction surveys performed at the Old River gate site in 1998 (Rooks pers. comm.). Den surveys were performed on several occasions between 1994 and 2001 for maintenance work performed at the previously proposed intake facility area on the northwest side of the CCF. No signs of recent kit fox activity were observed during these surveys. Preconstruction surveys were conducted in 1998 for the Old River at DMC gate because there was one USFWS record of kit fox near that gate site. Although there is a lack of optimal breeding habitat in the project area, some of the occurrences mentioned are very close to the Old River gate and dredging areas. Therefore, it is likely that kit fox could forage in the vicinity of the Old River gate and dredging areas.

California Black Rail

The California black rail occupies tidal emergent wetlands in the study area. The dominant vegetation in marshes inhabited by California black rail is generally dominated by tules or cattails. Nests are built in the lower portions of emergent wetlands. The California black rail nests from mid-March through July. During winter, black rails may be widely distributed in the marshes and may use the upper marsh vegetation for cover, especially during extreme high tides or high flow events (Zeiner et al. 1990b).

DWR mapped approximately 121 acres of tidal emergent wetland in the study area (Table 6.3-3). This land cover type occurs in varying densities throughout the study area and may include small or large patches of emergent wetland vegetation at the toe of the levees or on the perimeter of in-channel islands. The larger patches of wetland vegetation may provide suitable nesting and foraging habitat for this species. There are no CNDDB records of California black rail in the vicinity of the gate sites or channel dredging areas; however, no formal surveys have been conducted for this species in the project area. High flow events during the winter could affect populations of this species if they occur in the project area because suitable high marsh habitat may not be available as refugia from such events.

A CNDDB records search identified seven occurrences in the study area (California Natural Diversity Database 2004). All of these occurrences were located along Old River and Middle River, north of the project area. The closest occurrence to the project area is approximately 3.5 miles north of the proposed Middle River gate. The CNDDB occurrences are from large in-channel islands that consist entirely of or are dominated by emergent wetland vegetation.

Cooper’s Hawk

Cooper’s hawks breed throughout most of California in a variety of woodland habitats, including riparian and oak woodlands. The CNDDB records search did not identify any occurrences of Cooper’s hawk in the study area (California Natural Diversity Database 2004). Formal surveys have not been performed to determine whether this species is present in the project area. However, Cooper’s hawk is expected to be a permanent resident in the study area. This species is also expected to occur as a transient and winter resident in the study area. Cottonwood willow woodland and valley oak riparian woodland provide nesting, roosting and foraging habitat for this species.

DWR mapped approximately 467 acres of cottonwood willow woodland and valley oak riparian woodland in the study area (Table 6.3-3). These land cover types are dominated by native woody riparian tree species that provide potential nest sites for Cooper’s hawk. These land cover types occur in varying densities throughout the study area and may include isolated trees or large patches of riparian vegetation along levees or on in-channel islands. Isolated trees and riparian woodlands that are present throughout most of the study area on in-channel islands, levees, and adjacent lands provide nesting habitat for this species.

Greater Sandhill Crane

Greater sandhill cranes may occur as winter residents; however, the study area is outside of the species’ traditional wintering areas in the Delta. It is estimated that between 3,400 and 6,000 greater sandhill cranes winter in the Sacramento Valley and the Delta (California Department of Fish and Game 2000, Pacific Flyway

Council 1997; Pogson and Lindstedt 1991). Suitable winter foraging habitat is present on agricultural and pasturelands in the study area. During winter, greater sandhill cranes feed on grasses, forbs, waste grains, small mammals, amphibians, snakes, and invertebrates (Zeiner et al. 1990b). They feed and roost in pastures, flooded and unflooded grain fields, and seasonal wetlands.

A CNDDB records search did not identify any occurrences of greater sandhill cranes in the study area (California Natural Diversity Database 2004). Formal surveys have not been performed to determine whether this species is present during the winter months. Agricultural and pasturelands within the study area support foraging habitat for greater sandhill cranes that breed or winter in the Delta. There are approximately 146,000 acres of agricultural and pasture lands in the study area that could provide foraging habitat for this species.

Northern Harrier

The northern harrier nests and roosts in tall grasses and forbs in wetlands and field borders (Zeiner et al. 1990b). It will roost on the ground in shrubby vegetation, often near the marsh edge (Brown and Amadon 1968). The northern harrier is a permanent resident in the project area, and the breeding range of the Delta population includes most of the Central Valley, the Delta, Suisun Marsh, and portions of the San Francisco Bay (Zeiner et al. 1990b).

Although formal surveys have not been performed for this species, northern harriers have been observed in the study area and are known to nest in at least one location near the northeast portion of the CCF (Rooks pers. comm.). A CNDDB records search did not identify any occurrences of northern harrier in the study area (California Natural Diversity Database 2004). In the project area, ruderal and wetland habitats provide suitable nesting and roosting habitat. Foraging habitat in the project area includes agricultural lands, pasturelands, and wetlands.

DWR mapped approximately 526 acres of ruderal habitat and 121 acres of wetlands in the study area (Table 6.3-3). These land cover types are dominated by grasses, forbs, and herbaceous wetland vegetation that provide suitable nesting and foraging habitat for the northern harrier. Ruderal vegetation occurs primarily on the inboard and outboard sides of the levees. Wetland vegetation in the study area typically occurs within or on the margins of the waterways. Wetland vegetation occurs in varying densities and may include small to large patches of vegetation along levees or on in-channel islands.

Short-Eared Owl

Breeding populations of short-eared owls have been extirpated from the San Joaquin Valley (Remsen 1978); however, this species still breeds in the southern portion of the Sacramento Valley (i.e., Yolo and Solano Counties), the Delta, and Suisun Marsh. Short-eared owls are more likely to occur in the project area during the winter months with migrating birds arriving in September and October and leaving in April (Zeiner et al. 1990b). The breeding season is from late March to July (Zeiner et al. 1990b). Nests are built on the ground in tall stands of grasses in lowland habitats near hunting grounds in marshes, meadows, and even agricultural fields (Grinnell and Miller 1944).

Although potential nesting and roosting habitat for short-eared owls occurs in ruderal habitats and seasonal wetlands throughout the study area, this species is not expected to breed in this area because breeding populations have been extirpated from the San Joaquin Valley. Agricultural and pasturelands in the study area provide suitable roosting and foraging areas for this species. There are no known recent nesting occurrences in the study area, and a CNDDB records search did not identify any occurrences of short-eared owl (California Natural Diversity Database 2004).

DWR mapped approximately 526 acres of ruderal habitat in the study area (Table 6.3-3). Ruderal habitat is typically dominated by grasses and forbs that provide suitable roosting and foraging habitat for the short-eared owl. Ruderal vegetation primarily occurs on the inboard and outboard sides of the levees. Seasonal wetland vegetation typically occurs on the margins of the waterways in the study area. Wetland vegetation occurs in varying densities and may include small to large patches of vegetation along levees or on in-channel islands.

Swainson's Hawk

Swainson's hawks are summer residents in the project area and small numbers of this species are known to winter in the Delta. In the Central Valley, 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). Swainson's hawks nest in mature trees, with valley oak, cottonwood, willows, sycamores, and walnuts the preferred tree species. Nest sites typically are located in the vicinity of suitable foraging areas. The primary foraging areas for Swainson's hawk include open agricultural lands and pastures (California Department of Fish and Game 1994).

DWR mapped approximately 467 acres of cottonwood willow woodland and valley oak riparian woodland in the study area (Table 6.3-3). These land cover types occur in varying densities and may include isolated trees or large patches of riparian vegetation along levees or on in-channel islands. Swainson's hawks are known to nest throughout the project area, including within the vicinity of the gate sites and the proposed channel dredging areas (California Natural Diversity Database 2004; Bradbury pers. comm.). Isolated trees and riparian woodlands that are present throughout most of the study area on in-channel islands, levees, and adjacent lands provide nesting habitat for this species. Agricultural and pasturelands within support foraging habitat for Swainson's hawks that breed or winter in the Delta. There are approximately 146,000 acres of agricultural and pasture lands in the study area that could provide foraging habitat for this species.

A CNDDB records search identified 39 occurrences in the SDIP study area (California Natural Diversity Database 2004). Nine of these occurrences occurred within approximately ½ mile of the proposed gate sites and channel dredging areas. Other projects for which Swainson's hawk nest site surveys were conducted include the South Delta Temporary Barriers Project, the Interim South Delta Program, and the Swainson's Hawk Conservation Program. These surveys, which took place from 1993 through 2001, were performed by boat and by car to determine the location of nest sites (Bradbury pers. comm.). Surveys were performed along all waterways that could be affected by the projects. A total of 55 territories were identified in the project area. Most of these territories, and in some cases specific nest trees, have been used for several years (Bradbury pers. comm.).

Tricolored Blackbird

Tricolored blackbirds are permanent residents in the Sacramento–San Joaquin Valley. Historically, tricolored blackbirds nested primarily in emergent wetlands (Neff 1937). Recent studies indicate that an increasing percentage of nest sites are found in areas where the dominant land cover type consists of riparian scrub vegetation, Himalayan blackberry stands, and grain fields, among other cover types (DeHaven et al. 1995). In the study area, suitable nesting habitat is present within extensive stands of emergent wetland vegetation and riparian scrub vegetation. No suitable breeding habitat is present at the gate sites because the wetland and riparian vegetation is frequently disturbed and covers a relatively small area that is unsuitable for nest colonies.

The tricolored blackbird breeding season is from mid-April to late July. Tricolored blackbirds have three basic requirements for selecting their breeding colony sites:

- open, accessible water;
- a protected nesting substrate, including flooded, thorny, or spiny vegetation; and
- a suitable foraging space providing adequate insect prey within a few miles of the nesting colony (Hamilton et al. 1995; Beedy and Hamilton 1997, 1999)

In the study area, tricolored blackbird foraging habitat includes ruderal vegetation dominated by grasses and agricultural fields (such as large tracts of alfalfa with continuous mowing schedules and recently tilled fields). There are approximately 146,000 acres of agricultural and pasture lands in the study area that could provide foraging habitat for this species. Tricolored blackbirds also forage occasionally in riparian scrub habitats and along marsh borders. Most tricolored blackbirds forage within 5 kilometers (3 miles) of their colony sites (Orians 1961) but commute distances of up to 13 kilometers (8 miles) have been reported (Beedy and Hamilton 1999).

DWR mapped approximately 121 acres of tidal emergent wetland and 266 acres riparian scrub in the study area (Table 6.3-3). These land cover types occur in varying densities throughout the study area and may include small or large patches of emergent wetland vegetation at the toe of the levees or on the perimeter of in-channel islands. The larger patches of wetland and riparian vegetation provide suitable nesting and foraging habitat for this species.

Tricolored blackbirds historically nested near the Old River at DMC gate site, and nest colonies likely occurred throughout the study area within suitable habitats. No tricolored blackbirds were observed during incidental surveys performed by DWR between 1992 and 2001 (Rooks pers. comm.). No suitable habitat is available at the gate sites. A CNDDB records search identified 4 occurrences in the study area.

Western Burrowing Owl

The western burrowing owl is a permanent resident throughout the Delta. Suitable habitat for burrowing owls occurs in ruderal 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. 1990b) as well as artificial burrows (e.g., culverts, concrete slabs, and debris piles). The owl's breeding season is from March to August, peaking in April and May.

A CNDDB records search identified 33 occurrences in the study area. Most of these records occurred south or west of CCF (California Natural Diversity Database 2004). Two of these occurrences were within approximately ½ mile of the proposed Old River gate. DWR conducted formal surveys for burrowing owls along CCF.

Nesting burrowing owls have been observed on the northwest side of the forebay (Rooks pers. comm.). No burrowing owls were observed at the gate sites during incidental surveys performed by DWR between 1996 and 2001. DWR performed formal surveys for the Old River at DMC gate in 1998. Although no owls or burrows were observed, this area may provide foraging habitat for this species. Surveys have not been performed at the dredging areas; however, burrowing owls may occur on the inboard and outboard sides of the levees adjacent to the channel dredging areas.

White-Tailed Kite

White-tailed kites inhabit open lowland grassland, riparian woodland, seasonal wetlands, and scrub areas. Some large shrubs or trees are required for nesting. In the project area, cottonwood willow woodland and valley oak riparian woodland provide nesting and roosting habitat for this species. Communal night roosting is common during the non-breeding season. Grasslands, agricultural lands and pasturelands in the study area support foraging habitat for white-tailed kite that breed or winter in the Delta.

Although no formal surveys have been performed for the SDIP, white-tailed kites have been observed in the study area. No nesting activity has been observed; however, suitable nest sites are present throughout the study area. Suitable nest trees occur throughout most of the study area on in-channel islands, on levees and on adjacent lands. White-tailed kites have been observed foraging in the vicinity of CCF (Rooks pers. comm.) and in the vicinity of the Old River channel dredging area (Jones & Stokes field observation). A CNDDB records search identified 1 occurrence in the study area. This record included a nesting pair that was observed along the DMC, approximately 3 miles southwest of the Old River temporary barrier site.

DWR mapped approximately 467 acres of cottonwood willow woodland and valley oak riparian woodland in the study area (Table 6.3-3). These land cover types are dominated by native woody riparian tree species that provide potential nest sites for white-tailed kites. Kites may also nest in trees located in adjacent uplands and near adjacent agricultural lands. There are approximately 146,000 acres of agricultural and pasture lands within the study area that provide foraging habitat for this species.

Giant Garter Snake

The giant garter snake is endemic to emergent wetlands in the Central Valley. Within the San Joaquin Valley, the giant garter snake is still presumed to occur in San Joaquin County at White Slough/Caldoni Marsh, approximately 20 miles north of the study area (U.S. Fish and Wildlife Service 1999a). The species' habitat includes marshes; sloughs; ponds; small lakes; and low-gradient waterways, such as small streams, irrigation and drainage canals, and rice fields (58 FR 54053, October 20, 1993). The giant garter snake is active from approximately May through October and hibernates during the remainder of the year.

The giant garter snake requires adequate water with herbaceous, emergent vegetation for protective cover and foraging habitat. All three habitat components (cover and foraging habitat, basking areas, and protected hibernation sites) are needed. Riparian woodlands and large rivers typically do not support giant garter snakes because these habitats lack emergent vegetative cover, basking areas, and prey populations (Hansen and Brode 1980).

A CNDDB records search identified one occurrence in the study area. This record included an individual that was observed along the Stockton Diverting Canal near the intersection of SRs 88 and 99, approximately 15 miles northeast of the head of Old River fish control gate and approximately 15 miles northeast of the Middle River channel dredging area. DWR performed surveys in the study area to determine the suitability of on-site habitats for giant garter snakes (Rooks pers. comm.). The surveys, which were performed in September 2002, included the Byron Tract–LDS Property, CCF, Grant Line Canal gate site, Old River at DMC gate site, and the Middle River gate site to assess the habitat value for giant garter snakes. The head of Old River fish control gate site was not evaluated because of lack of permission to enter. DWR used a species-specific evaluation method to describe the quality of the potential giant garter snake habitat found on the landside of each site (Hansen 2002).

The study area provides low to moderate value habitat for this species (Rooks pers. comm.). The surveys determined that the exterior levees provide no habitat value to giant garter snakes. The areas of highest value include toe drains and irrigation ditches on the various islands in the study area. Wetland land cover types on the inboard side of the levees have not been mapped so the quantity of suitable giant garter snake habitat in these areas has not yet to be determined.

Western Pond Turtle

Western pond turtles inhabit permanent or nearly permanent waters with little or no current (Behler and King 1998). The channel banks of inhabited waters usually have thick vegetation, but basking sites such as logs, rocks, or open banks must also be present (Zeiner et al. 1988). Rivers, sloughs, ponded water bodies and some agricultural ditches and canals in the study area provide suitable habitat for this species. Eggs are laid in nests along sandy banks of large slow moving streams or in upland areas, including grasslands, woodlands, and savannas. Nest sites are typically 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).

Western pond turtles occur throughout the study area, including the gate sites and the channel dredging area. A CNDDB records search identified 9 occurrences in the study area. Surveys performed for the ISDP identified numerous occurrences of western pond turtle in the study area. Surveys performed by DWR in summer 2000 and 2001 identified additional occurrences. The DWR surveys were completed by boat at various times throughout the day and during different periods in the tidal cycle. Turtles were observed throughout the study area in varying densities and were found at the gate sites, channel dredging areas and around CCF (Rooks pers. comm.).

Valley Elderberry Longhorn Beetle

Elderberry shrubs are the host plant of the federally listed VELB. Current information on the habitat of the beetle indicates that it is found only with its host plant, the elderberry. Adult VELB feed on foliage and are active from early March through early June. The beetles mate in May and females lay eggs on living elderberry shrubs. Larvae bore through the stems of the shrubs to create an opening in the stem within which they pupate. After metamorphosing into an adult, the beetle chews a circular exit hole through which it emerges (Barr 1991).

Elderberry shrubs in California's Central Valley are commonly associated with riparian habitat but also occur in oak woodlands and savannas and in disturbed areas. Elderberry shrub locations were mapped by DWR in the study area during the 2000–2001 vegetation mapping surveys. A total of 63 elderberry shrubs or shrub clusters were observed during the surveys (Spanglet pers. comm.). The vegetation surveys were performed by slowly moving along the waterways in a boat (Spanglet pers. comm.). When an elderberry shrub or cluster was observed its location was identified using GPS and notes regarding the size of the shrub or shrub cluster were recorded.

Although USFWS protocol surveys have not been conducted, suitable habitat (i.e., elderberry shrubs) occurs throughout the study area. Protocol level surveys will be performed before beginning construction activities to determine the number of shrubs that will be affected and to determine if VELB exit holes are present. Elderberry shrubs were observed along Middle River, Old River, and Grant Line Canal with the highest concentrations occurring along Middle River. Elderberry shrubs on Middle River are located in the vicinity of the channel dredging areas. No elderberry shrubs were observed at the gate sites.

Environmental Consequences

Assessment Methods

Impact Mechanisms

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

- vegetation removal, grading, and paving activities during gate construction, building activities, dredging, and siphon extensions;
- channel dewatering or installation of temporary water-diversion structures;
- temporary stockpiling and sidecasting of soil, construction materials, or other construction wastes;
- placement of dredged material in the temporary settling basins that would be constructed on agricultural lands
- temporary disturbance of agricultural lands and ruderal habitat on the landside of levees during dispersal of dredged materials.

Impact Analysis Assumptions

The SDIP would result in temporary and permanent impacts on vegetation resources in the project area. Temporary impacts are those that typically occur only during the construction period or during the maintenance dredging period, which will be conducted one time within 3–5 years after construction. Permanent impacts would be irreversible changes in land cover types.

The project understandings and assumptions used in assessing the magnitude of possible impacts on wildlife and wildlife habitat were the same as those identified in Section 6.2, Vegetation and Wetlands.

Impact Assessment Approach and Methods

This wildlife resources impact analysis is based on the following:

- the most current SDIP alternatives, as developed by DWR and summarized in the above assumptions;
- existing biological resource information (sources are discussed in Affected Environment); and
- current baseline conditions (as of 2000–2001 and 2003 field surveys).

The mitigation measures for impacts on wildlife resources were developed in part through review of the MSCS (CALFED Bay-Delta Program 2000e) and prior environmental impact studies and reports for affected resources.

Impacts in the following sections are grouped into construction-related impacts, which include impacts resulting from construction of the gates and dredging at the gate sites, 3 dredge areas and siphon sites, and by operational impacts, which include impacts resulting from operation of gates (i.e., changes in water elevation/tidal regime). Most construction impacts address all project components, but for clarity some construction impacts are divided into gate construction, dredging at gates, and dredging at the three channel dredging areas and siphon sites.

Significance Criteria

The criteria for determining significant impacts on biological resources were developed by reviewing State CEQA Guidelines and the CALFED Programmatic EIS/EIR (CALFED Bay-Delta Program 2000b). Based on these sources of information, constructing and operating the SDIP may result in a significant impact if it would result in:

- a temporary or permanent loss or degradation of any riparian, wetland or other sensitive natural community identified in local, state, or federal regional plans, policies or regulations;
- a temporary or permanent disruption of wildlife movement or fragmentation or isolation of riparian habitats;
- a temporary or permanent loss or disturbance of important upland land cover types used by wildlife for breeding, roosting or foraging habitat;

- a temporary or permanent loss or disturbance of important agricultural land cover types used by wildlife for breeding, roosting or foraging habitat;
- direct mortality to, or lowered reproductive success of, federally or state-listed wildlife species or loss of habitat of these species, including the loss of occupied or suitable habitat for these species;
- direct mortality to, or lowered reproductive success of, substantial portions of local populations of species that are candidates for federal or state listing or that are California species of special concern, including the loss of occupied or suitable habitat for these species; and
- temporary disturbance or mortality of special-status species resulting from implementation of mitigation measures or habitat management actions.

Beneficial effects include changes that would result in net increases in the extent or quality of native riparian, wetland, or upland wildlife habitats. Substantial beneficial effects are identified as significant effects.

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project specific actions. The mitigation measures address the short-term, long-term and cumulative effects of the CALFED Program.

The discussion of significant impacts and mitigation measures within this section will include a citation of one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the SDIP. These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to the SDIP resource area are listed below; therefore, numbering may appear out of sequence. To see a full listing of CALFED programmatic mitigation measures, please refer to Appendix E, "Mitigation Measures Adopted in the CALFED Record of Decision."

CALFED Programmatic Wildlife Mitigation Measures

1. Avoid direct or indirect disturbance to wetland and riparian communities, special-status species habitat, rare natural communities, significant natural areas, and other sensitive habitat.
2. Restore and enhance sufficient in-kind wetland and riparian habitat or rare natural communities and significant natural areas at off-site locations (near project sites) before or at the time that project impacts are incurred. Replace not only acreage lost, but also habitat value loss.
3. Design Program features to permit on-site mitigation or nearby restoration of wetland, riparian habitat, special-status species habitat, rare natural

communities, and significant natural areas that have been removed by permanent facilities.

4. Phase the implementation of ERP habitat restoration to offset temporary habitat losses and to restore habitat (including special-status species habitat) before, or at the same time that, project impacts associated with the ERP are incurred.

5. Restore wetland and riparian communities, special-status species habitat, and wildlife use areas temporarily disturbed by on-site construction activities immediately following construction. Example actions include direct planting of native plants, controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow for the natural reestablishment of the affected plant community.

11. Avoid important wildlife habitat areas, such as critical deer winter range and fawning habitat.

12. Restore and enhance important wildlife habitat use areas temporarily disturbed by on-site construction activities by planting and maintaining native species immediately following construction.

13. Restore and enhance upland habitat areas within affected watersheds or in other watershed if sufficient habitat enhancement is unavailable within the affected watershed. This could include modifying existing land management practices (for example, grazing and fire management practices) to improve conditions for the natural reestablishment and long-term maintenance of affected plant communities and habitats.

14. Avoid direct or indirect disturbance to areas occupied by special-status species.

15. Avoid construction or maintenance activities within or near occupied special-status species habitat areas or important wildlife use areas when species may be sensitive to disturbance, such as during the breeding season.

16. Restore habitat areas occupied by special-status species that are temporarily disturbed by on-site construction activities immediately following construction.

17. Restore and enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been affected by the permanent removal of occupied habitat areas.

19. For species for which relocation or artificial propagation is feasible, establish additional populations of special-status species adversely affected by the Program in suitable habitat areas elsewhere within their historical range.

20. Avoid direct or indirect disturbances to rare natural communities and significant natural areas.

21. Restore or enhance disturbed rare natural communities or significant natural areas at off-site locations before, or when, Program actions that could affect these communities are incurred.

22. Restore rare natural communities or significant natural areas at or near affected locations after Program activities are completed.
23. Manage recreation-related activities on lands managed under the Program to minimize or avoid potential adverse effects of recreation-related activities on sensitive habitats, important wildlife use areas, and special-status species.
24. Phase ERP to initially restore natural waterfowl foraging on agricultural lands with low forage value while restored habitat with high forage value develops.
25. Phase ERP to initially restore wetland habitat with high forage value to offset the loss of agricultural foraging habitat that may result from the ERP.
26. Restore riparian vegetation disturbed by on-site construction activities immediately following construction.
27. Restore or enhance sufficient in-kind riparian habitat at off-site locations, near project sites, in a manner that reduces the degree of existing habitat fragmentation before, or when, project impacts are incurred to offset habitat losses.
28. Restore habitat temporarily disturbed by on-site construction activities immediately following construction.
29. Restore rare natural communities, significant natural areas, and wildlife use areas temporarily disturbed by on-site construction activities immediately following construction. Example actions include direct planting of native plants, controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow for the natural reestablishment of the affected plant community.
30. Restore and enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been adversely affected by the permanent removal of occupied habitat areas.

Alternative 1 (No Action)

Impact WILD-1: Potential for Adverse Effects on Wildlife Species at the Existing Barrier Locations

If the SDIP were not implemented, the fish control and flow control gates, as well as an increase in diversion and pumping would not be built or operated. The State Water Project would also continue to operate under its currently permitted pumping capacity of 6,680 cfs. All of the existing temporary barriers (head of Old River, Middle River, Grant Line Canal, and Old River barriers) would continue to be installed and removed annually. No dredging would occur under Alternative 1.

The effects on existing land cover types and wildlife resources from Alternative 1 would be limited to the existing barrier footprints, which are currently disturbed on an annual basis. No new riparian or wetland habitat would be expected to colonize the barrier footprints during the periods between removal and installation of the barriers. Because effects on land cover types within the barrier footprints would not substantially reduce existing habitat values or change the current conditions that could affect common or special-status wildlife species there would be no increase in adverse effects over existing conditions.

2020 Conditions

Under Future No Action conditions (2020 conditions), SDIP would not be implemented. It is expected that the temporary barriers program would continue. Activities involved with placing and removing fill within perennial aquatic habitat would continue to have a significant impact on water quality, aquatic habitat, and adjacent terrestrial land cover types. These effects have been mitigated as part of the original project. It is expected that the effects on wildlife and wildlife habitat attributable to placement of the temporary barriers would remain the same as existing conditions.

Alternatives 2A, 2B, and 2C

Stage 1 (Physical/Structural Component)

This section summarizes the analysis of project-related effects on wildlife and wildlife habitat as a result of gate construction, channel dredging, and agricultural siphon extension under Alternatives 2A–2C. The alternative analysis has been combined for these four alternatives because the physical and structural components are the same for each of these alternatives.

The following sections address both species impacts and wildlife habitat impacts. Wildlife habitat impacts may affect all species, including special-status species and common wildlife species, whereas species impacts focus on specific special-status species. Mitigation measures were developed for both habitat and species impacts. A mitigation measure may apply to more than one impact.

Impact WILD-2: Loss of Riparian-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate Construction. Construction of the flow control gates at Middle River, Grant Line Canal, and Old River would result in the permanent loss of up to 0.21 acre of woody riparian communities, including cottonwood-willow riparian woodland, riparian scrub, and willow scrub (Table 6.3-6). No riparian vegetation occurs at the head of Old River fish control gate site. The distribution of riparian impacts at the gate sites is described in Section 6.2, Vegetation and Wetlands.

Permanent impacts on riparian vegetation for each gate site would include all land within the gate footprints, all facilities associated with each gate and the extent of levee upstream and downstream of each gate where slope protection would be placed. Impacts on riparian vegetation may include the complete removal of trees and shrubs, limb pruning and disruption of the root zone as a result of ground disturbing activities.

The loss of riparian habitat as a result of gate construction would also result in fragmentation of existing riparian habitats. Although some of the existing riparian vegetation is fragmented and composed of disjunct patches of vegetation that is separated by the temporary barriers, loss or further fragmentation of riparian habitat in the vicinity of the permanent gate sites is considered to be significant. Gate construction at the Grant Line Canal, Middle River, and Old River sites would result in the permanent removal or fragmentation of riparian habitat in locations that were not previously affected by the temporary barriers. The additional fragmentation of riparian habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community.

Channel Dredging. In addition to the dredging required to construct the gates, portions of West Canal, Middle River, and Old River would be dredged to improve conveyance and the operation of private agricultural siphons and pumps (Table 6.3-6). Sealed clamshell dredging at the three flow control gate sites would avoid impacts on riparian vegetation. Dredging at the head of Old River fish control gate would not affect any riparian vegetation.

The use of hydraulic dredging in West Canal, Middle River, and Old River would minimize, but not entirely avoid, temporary impacts on woody riparian vegetation because of the placement of the stationary pipes for dredged material on the levee face. Pockets of riparian vegetation occur on the levees between Middle River and Union and Roberts Islands. The exact locations of stationary pipes to transport dredged material over the levees to dredge disposal areas are currently unknown, but placement of pipes on the levee banks would temporarily affect up to a maximum of 16 locations of woody riparian vegetation throughout the three conveyance dredge areas. Assuming removal of vegetation in a 10-foot-wide band for placement of each of the 16 stationary pipes and an estimated levee face height of 15 feet, up to 0.06 acre (2,400 square feet) of woody riparian vegetation would be removed. DWR would avoid placing pipe in woody riparian vegetation to the extent possible. This impact conservatively assumes the maximum possible impact, and the actual impact would likely be less. This impact would continue for up to 5 years after initial dredging, until the pipes were removed and the banks were revegetated. This impact is considered significant.

Sealed clamshell dredging of channels, if used in the conveyance dredge areas, would avoid direct impacts on all riparian vegetation. Clamshell dredging at siphon locations would not have an impact on woody riparian vegetation.

Temporary indirect impacts of dredging adjacent to the gate sites, at all three conveyance dredge locations, and at siphon extensions could include decreased water quality levels caused by turbidity. Riparian vegetation near the waterline would not likely be significantly affected by the temporarily small increase in water turbidity.

The temporary impacts on up to 0.06 acre of woody riparian vegetation as a result of conveyance dredging would be considered significant. The loss of woody riparian vegetation would reduce the extent of riparian communities,

Table 6.3-6. Land Cover Impacts Associated with Gate Construction and Dredging—Alternatives 2A–2C

		Acreages Affected by Gate Construction					Acreages Affected by Dredging[1]							
Wildlife Habitats	Land Cover Type	Middle River Flow Control Gate	Grant Line Canal Flow Control Gate	Old River at DMC Flow Control Gate	Head of Old River Fish Gate	Total Permanent Impacts Associated with Gate Construction	Gate Sites	West Canal Conveyance Dredging Area	Middle River Conveyance Dredging Area	Old River Conveyance Dredging Area	Total Temporary Impacts Associated with Dredging	Temporary Impacts Associated with Agricultural Diversions	Permanent Impacts Associated with Agricultural Diversions	Impacts Associated with Dredge Material Disposal[4]
Tidal perennial aquatic habitat	Tidal perennial aquatic	0.16	0.32	0.26	0.14	0.88	29.82	73.02	72.67	123.46	298.97	0.06	<0.01	0
Tidal freshwater emergent marsh habitat	Tule and cattail tidal emergent wetland	0.07	<0.01	<0.01	0	<0.08	0	0	0	0	0	0	0	0
Riparian Woodland	Cottonwood-willow woodland	0	0.03	0	0	0.03	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
	Valley oak riparian woodland	0	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian Scrub	Riparian scrub	0.02	0.03	0.12	0	0.17	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
	Willow scrub	0	0	<0.01	0	<0.01	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
	Willow scrub wetland	0	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Agricultural Land	Agricultural land	0.50	0.25	2.00	0	2.75	4.80[3]	0	0	0	0	0	0	101.50
Ruderal	Ruderal	0	0.02	0	0.02	0.04	0	0	0	0	0	0	0	47.40

DMC = Delta-Mendota Canal.

1 Dredge impacts assumed impacts on all tidal perennial aquatic habitat within the dredge area. Actual loss of tidal perennial aquatic habitat will probably be less as a result of confining dredge activities to the center of the channel.

2 Dredge impacts on individual riparian land cover types are not yet determined because the exact placement of the stationary pipes has not been identified. The riparian impact will total up to 0.06 acre at the three dredge areas.

3 The acreage for the gate site agricultural impact includes the areas used for dredge drying areas at all four gate sites, which was assumed to require 1.2 acres at each site. This represents a permanent impact.

4 The acreage for dredge drying areas at the three conveyance dredging areas is a temporary impact.

which are rare natural communities. Implementation of the mitigation measures listed below and environmental commitments (Chapter 2) would reduce this impact to a less-than-significant level.

Siphon Extensions. Hydraulic dredging at siphon locations would not require placement of additional stationary pipes for removal of dredged material. No additional impact on woody riparian vegetation would occur.

The permanent impacts on 0.21 acre and the temporary impacts on 0.06 acre of woody riparian vegetation as a result of gate construction and channel dredging, respectively, are considered significant. The loss of up to 0.21 acre of woody riparian vegetation as a result of project construction would be considered a significant impact because it would result in the loss of woody riparian vegetation and the reduction in the extent of riparian communities, which are rare natural communities. Implementation of Mitigation Measures WILD-MM-1, WILD-MM-2, and WILD MM-3 would reduce this impact to a less-than-significant level.

Mitigation Measure WILD-MM-1: Replace Riparian Land Cover Types. Impacts on riparian habitat will be mitigated by implementing Mitigation Measure VEG-MM-2: Compensate for unavoidable temporary and permanent loss of riparian habitats, as described in Section 6.2, Vegetation and Wetlands. This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, and 5.

Mitigation Measure WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. The study area is located in and adjacent to habitat that supports nesting birds protected under the Migratory Bird Treaty Act (MBTA). Protective fencing will be used to protect nesting habitat outside of the construction and maintenance areas. DWR will perform preconstruction surveys to determine whether nesting birds, including migratory birds, raptors, and special-status bird species, are present within or immediately adjacent to the gate sites and associated staging and storage areas.

DWR will remove all woody and herbaceous vegetation from the construction areas during the nonbreeding season (September 1–February 1) to minimize effects on nesting birds. During the breeding season all vegetation will be maintained to a height of approximately 6 inches to minimize the potential for nesting. If construction occurs during the breeding season and all affected vegetation has not been removed, a qualified biologist will survey the construction area for active nests and young migratory birds immediately before construction. If active nests or migratory birds are found within the boundaries of the construction area, DWR will develop appropriate measures and will inform DFG of its actions. Inactive migratory bird nests (excluding raptors) located outside of the construction areas will be preserved. If an inactive migratory bird nest is located in these areas, it will be removed before the start of the breeding season (approximately February 1).

If an active raptor nest is found outside of the construction areas, a buffer zone will be created around the nest tree. The recommended buffer, as identified by DFG, is 250 feet (Sections 3503 and 3503.5 of the California Fish and Game Code). A larger buffer zone shall be established around Swainson's hawk nest sites, as described under Mitigation Measure WILD-MM-10: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites.

Mitigation Measure WILD-MM-3: Minimize Impacts on Sensitive Biological Resources. DWR will include the following measures to minimize indirect impacts on wildlife and wildlife habitat:

1. DWR will provide an on-site biologist/environmental monitor who will be responsible for monitoring implementation of the conditions in the state and federal permits (CWA Section 401, 402, and 404; ESA Section 7; "Fish and Game Code Section 1601"; project plans (SWPPP); and EIS/EIR mitigation measures).
2. The on-site biologist/environmental monitor will determine the location of environmentally sensitive areas adjacent to each gate site and channel dredge areas based on existing land cover type and special-status plant species mapping (Figures 6.2-2 through 6.2-9), unless actual field conditions warrant a modification of the environmentally sensitive area boundaries. To avoid construction-phase disturbance to sensitive habitats immediately adjacent to the project site, the monitor will identify their boundaries and add a 50-foot buffer where feasible with orange construction barrier fencing. The fencing will be mapped on the project construction drawings. Erosion control fencing will also be placed at the edges of construction where the construction activities are upslope of wetlands and channels to prevent washing of sediments from the construction site into surrounding environmentally sensitive areas. The environmentally sensitive area and erosion-control fencing will be installed before any construction activities begin and will be maintained throughout the construction period.
3. DWR will provide a worker environmental training program for all construction personnel prior to the start of construction activities. The program will educate workers about special-status species, riparian habitats, and waters of the United States present on and adjacent to the site, and the regulations and penalties for unmitigated effects on these sensitive biological resources.
4. Landing on in-channel islands, anchoring boats and/or barges to these islands, and construction personnel encroaching on the islands will be prohibited. The exception to this measure is at Grant Line Canal where the utility lines will cross the island and construction personnel will have to access the utility corridor during installation.
5. Where feasible, construction will avoid and minimize trimming or complete removal of vegetation.
6. Following construction at the gate sites, the construction contractor will remove all trash and construction debris and implement a revegetation plan

for temporarily disturbed vegetation in the construction zones. The elements that should be included in the revegetation of these sites are described in Mitigation Measures VEG-MM-2 and VEG-MM-7.

This mitigation measure is consistent with CALFED Mitigation Measures 2, 3, 4, 5, and 6.

Impact WILD-3: Loss of Tidal Emergent Wetland–Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate Construction. Gate construction would result in the permanent loss of 0.08 acre of tidal emergent wetland, including the permanent loss of 0.07 acre associated with the Middle River flow control gate and less than 0.01 acre at both the Grant Line and Old River at DMC gates (Table 6.2-6). No tidal emergent wetland occurs at the head of Old River fish control gate site. Construction would avoid impacts on tidal emergent wetland located on the in-channel island in the project area.

Channel Dredging. Sealed clamshell dredging at the three flow control gate sites and the siphon extension locations and hydraulic or clamshell dredging in the three conveyance dredge areas would not result in any additional direct impacts on tidal emergent wetland (Table 6.2-6). Indirect impacts of dredging adjacent to the gate sites, at all three conveyance dredge locations and at the siphon extension locations could include decreased water quality levels caused by turbidity. Tidal emergent wetland vegetation would not be significantly affected by the temporary, small increase in channel water turbidity.

The permanent impact on up to 0.08 acre of tidal emergent wetland would be considered significant because the wetlands are waters of the United States and are regulated under Section 404 of the CWA. Implementation of Mitigation Measures WILD-MM-2, WILD-MM-3, and WILD-MM-4 would reduce this impact to a less-than-significant level.

Mitigation Measure WILD-MM-4: Replace Wetland Land Cover Types. Impacts on wetlands will be mitigated by implementation of Mitigation Measure VEG-MM-7: Compensate for Unavoidable Impacts on Tule and Cattail Tidal Emergent Wetlands, as described in Section 6.2, Vegetation and Wetlands. Where impacts on wetlands cannot be avoided, the area of effect will be kept to the minimum possible. Loss of, or impacts on, these habitats will be compensated for as part of compliance with the state and federal wetland permitting process.

Impact WILD-4: Loss of Tidal Perennial Aquatic–Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate construction would result in the permanent removal of 0.88 acre of tidal perennial aquatic habitat within the gate footprints. Tidal perennial aquatic habitat at the four gate sites is currently affected each year by the placement of fill material to build temporary barriers in the spring and the subsequent removal of the material in the fall. The proposed construction of gates would permanently remove this aquatic habitat within the gate footprint. Structures within the footprint would vary at each gate site but would include gate structures, boat passages, and fish passages. During construction, additional area upstream and downstream of the permanent gate would be temporarily affected by placement of sheetpile-braced cofferdams and channel dredging associated with gate construction.

Temporary disturbance of tidal perennial aquatic habitat would occur during construction of the three flow control gates and the fish control gate, channel dredging, and construction of siphon extensions. Temporary disturbance would occur as a result of any dewatering activities required for gate construction, as well as work in the channel associated with dredging and placement of additional siphon pipeline. Temporary impacts on tidal perennial aquatic habitat are discussed in more detail as they relate to sedimentation and scouring (Section 5.6, Impact SS-1) and fish (Section 6.1, Impacts Fish-1, Fish-14, and Fish-21).

Tidal perennial aquatic habitat in the gate dredging and conveyance dredging areas includes deepwater aquatic, shallow aquatic, and unvegetated intertidal zones. A total of 298.97 acres of tidal perennial aquatic habitat occurs in the gate site and conveyance dredging areas. However, impacts from dredging would be temporary and would affect primarily water quality. The actual dredged area footprint is expected to be less than 298.97 acres because not all of the tidal perennial aquatic habitat in these areas will be dredged. However, because the exact boundaries of dredging have not been identified, it is assumed that the entire area will be affected.

Temporary construction staging for the 24 siphon extensions would occupy approximately 100 square feet of channel at each location (Figure 2-11), for a project wide impact of approximately 0.06 acre (2,400 square feet) of perennial tidal aquatic habitat. Siphon extensions at up to 24 locations would result in a small amount (0.007 acre) of permanent fill of tidal perennial aquatic habitat. Each siphon would be extended to a depth of –3 to –5 feet msl. The pipe extensions would be a maximum of 2 feet in diameter and 6 feet long, for a total of 12 square feet each. The total of 24 siphon extensions placed within the tidal aquatic area would fill a maximum of 288 square feet (0.007 acre) of the channel bed. Spot dredging for maintenance of existing agricultural diversions has been addressed in the BO issued by USFWS for the South Delta Temporary Barriers Project. NOAA Fisheries issued BOs for the South Delta Diversions Dredging and Modification Project and the South Delta Temporary Barriers Project (U.S. Fish and Wildlife Service 2001 and National Marine Fisheries 2003 and 2001 respectively). A streambed alteration agreement (# BD-2002-0002) was issued by the DFG for Dredging and Modification of Selected Diversions in the South Delta. These documents address impacts related to both the dredging and modification of the existing agricultural siphons and pumps in the south Delta. Therefore, there will be no additional consultation related to this impact.

Gate operations would not result in an overall loss of tidal perennial aquatic habitat, but zone types could change between deepwater, shallow water, and tidal flats in the area upstream of the gates (e.g., more tidal flat because of the increased tidal range caused by gate operation). The individual acreage of each of these three zones has not been determined; therefore, the potential variation in abundance cannot be determined. The operations-related effect on tidal perennial aquatic habitat, overall, would not be considered significant because these zones would be expected to reestablish as the system adapts to new water level fluctuations. Fish and other aquatic wildlife occupy this habitat.

Permanent loss of up to 0.88 acre of tidal perennial aquatic habitat would be a significant impact. Implementation of Mitigation Measures WILD-MM-3 and WILD-MM-5, below, would reduce this impact to a less-than-significant level. No mitigation would be required for the temporary disturbance of tidal perennial aquatic habitat resulting from channel dredging.

Mitigation Measure WILD-MM-5: Compensate for Loss of Tidal Perennial Aquatic Habitat. DWR will compensate for the permanent loss of up to 0.88 acre of tidal perennial aquatic habitat caused by construction of the gates at a ratio of 2 to 3 acres for each acre affected, for a total of up to 1.76 to 2.64 acres. This mitigation is consistent with the MSCS Conservation Measure for tidal perennial aquatic habitat to "restore or enhance 2 to 5 acres of additional in-kind habitat for every acre of affected habitat near where impacts on habitat are incurred" (CALFED Bay-Delta Program 2000e).

The 1.76 to 2.64 acres of tidal perennial aquatic habitat would be purchased as mitigation credits from an appropriate mitigation bank in the project vicinity. One potential site is the Kimball Island Mitigation Bank.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Temporary disturbance of agricultural land and ruderal habitat would occur during construction of the gates, channel dredging, and siphon extension construction. Temporary disturbance would occur as a result of any dewatering activities required for gate construction, as well as work in the channel associated with dredging and placement of additional siphon pipeline. The effects of gate construction, channel dredging, and siphon extensions are described below.

Gate Construction. Construction at the four gate sites would result in the permanent removal of up to 2.75 acres of agricultural land and 0.04 acre of ruderal vegetation. Agricultural land impacts include an approximately 2.0-acre area at the Old River at DMC gate site. An additional 0.50 and 0.25 acre of agricultural land would also be affected at Middle River and Grant Line Canal gate sites, respectively. Approximately 4.80 acres of agricultural land would be permanently affected by construction of the permanent settling basins adjacent to each gate.

Conveyance Dredging. Approximately 165 acres of settling ponds or runoff management basins would be constructed as part of the conveyance dredging action. The potential locations of the settling ponds or runoff management basins have been identified and mapped, although specific sites have not been selected. It is assumed, however, that all dredged material disposal areas would be constructed on agricultural land adjacent to the dredge operations. DWR is committed to minimizing impacts on sensitive habitats, including wetlands, and special-status species, and will construct the ponds or basins on agricultural land. These factors will play a major role in the determination of the dredged material disposal sites. These dredge ponds or basins would remain in use for up to 7 years and then would be returned to agricultural use.

Siphon Extensions. Dredge spoils associated with siphon extensions would be placed in the settling basins described above.

The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the project area. No mitigation is required. Implementation of environmental commitments (see Chapter 2) and Mitigation Measures WILD-MM-2 and WILD-MM-3 from above would restore the preproject habitat values of these sites following the completion of construction and dredging activities.

Potential effects on special-status species from the loss of agricultural land and ruderal habitat, as well as associated mitigation measures, are described below under the sections related to individual species.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

The operation of heavy equipment during construction activities could affect wildlife species that are unable to relocate, such as small mammals, amphibians, reptiles, and nesting birds. Construction activities could result in direct mortality to common wildlife species. Construction activities would also temporarily disturb the use of affected or adjacent land cover types by wildlife.

The potential for temporary disturbance and possible mortality of common wildlife species is considered less than significant because temporary and periodic use of heavy equipment would not substantially change the amount of disturbance currently occurring in the area. Additionally, vegetation protection measures will be incorporated as an environmental commitment and preconstruction surveys will be performed before starting construction activities. No mitigation is required.

Impact WILD-7: Disruption of Wildlife Movement Corridors as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate Construction. Under existing conditions the temporary barriers are in place between approximately April and October each year. During other times of the year, the barriers are removed and water flows unimpeded. The seasonal barriers were constructed of rock and had no facilities on top of the barrier.

Terrestrial and aquatic wildlife could pass over or around these barriers to move across the waterways or to move upstream and downstream of these structures.

Construction of the gates would result in the placement of permanent structures in the waterways at the sites of the temporary barriers. The permanent gates would be constructed of concrete and would consist of vertical walls, road surfaces, parking areas, and facilities and would be impassable to some wildlife species that may have moved across the temporary barriers. The permanent gates may result in a disruption of wildlife movement corridors compared to the temporary barriers.

Although terrestrial species will move around the gates via the levees, movement of some aquatic wildlife may be impeded during those periods when the gates are closed. Initial gate construction activities may result in a disruption of movement between breeding and rearing habitat and established feeding areas for individuals or family groups. Once the gates are operational, it is unlikely that wildlife species will frequently pass through the gates.

Channel Dredging. Channel dredging may have a temporary effect on aquatic wildlife movement corridors or individuals while dredging activities are in progress; however, most individuals are expected to move through the dredging areas or into other aquatic habitats during working and non-working periods.

The effects of gate construction and operation on wildlife movement corridors are considered less than significant because once the gates are operational, it is unlikely that wildlife species will frequently pass through the gates, and passage will become available when the gates reopen. No mitigation is required.

Impact WILD-8: Loss of Valley Elderberry Longhorn Beetle or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate Construction. Elderberry shrub locations were mapped by DWR in the study area during 2000–2001. Elderberry shrubs and areas of suitable habitat for elderberry shrubs occur throughout the study area. Elderberry shrubs occur at scattered locations throughout the study area, including Middle River, Old River, and Grant Line Canal, with the highest concentrations occurring along Middle River. Most of the shrubs and shrub clusters in the study area are located on the levees. No elderberry shrubs occur within the gate construction sites. Access roads associated with gate construction would be restricted to the top of the levee of existing farm roads on the inboard side of the levee. Vehicle access could occur within the USFWS's recommended 100-foot buffer zone.

Channel Dredging. Elderberry shrub locations were mapped by DWR in the study area during 2000–2001. Elderberry shrubs and areas of suitable habitat for elderberry shrubs occur throughout Middle River channel dredging area. A small number of elderberry shrubs were observed in the vicinity of the Old River channel dredging area. No elderberry shrubs were observed along the West Canal.

Most of the shrubs and shrub clusters are located on levees. Dredging vehicle and equipment access could occur in the vicinity of elderberry shrubs. Hydraulic channel dredging would include use of a stationary pipe braced to the waterside of the levee, extended across the top, and down the landside of the levee into the primary basin of a settling pond. Clamshell dredging would occur from a barge or from a dredge sitting atop the levee. A 100-foot-long bucket assembly arm would scoop material from the channel and deposit it into a runoff basin on the landside of the levee. It is anticipated that some elderberry shrubs may occur close to dredging areas and that dredging activities may occur within the preferred avoidance zone established by USFWS. No soil disturbing activities are anticipated, and DWR will take special precautions to ensure that elderberry shrubs are not affected by dredging or other activities. Although no effects are anticipated at this time, elderberry shrubs and associated habitat could be inadvertently damaged by channel dredging activities.

The potential effects on VELB habitat are considered significant. Implementation of Mitigation Measures WILD-MM-6, WILD-MM-7, and WILD-MM-8 would reduce this impact to a less-than-significant level.

Mitigation Measure WILD-MM-6: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs. A qualified biologist will perform an elderberry shrub survey before starting gate construction, channel dredging, and sediment disposal activities and mitigation site implementation to ensure that elderberry shrubs, if present, are identified. The on-site biologist will field stake the locations of elderberry shrubs and shrub clusters, if present, before construction begins. Orange exclusion fencing will be installed around each elderberry shrub and shrub cluster. DWR will attempt to perform construction and dredging operations without affecting elderberry shrubs and to maintain a 100-foot buffer zone around all elderberry shrubs, to the greatest extent possible. However as a result of the dimensions of the work areas, it is anticipated that work could occur within the 100-foot buffer zone.

The surveys will be performed according the USFWS VELB compensation guidelines (U.S. Fish and Wildlife Service 1999b). During the preconstruction and postconstruction surveys the following information will be recorded for each shrub or shrub cluster:

- the number of stems greater than 1-inch in diameter;
- the number of stems less than 1-inch in diameter;
- the approximate height and width of the elderberry shrub or shrub cluster;
- the presence of VELB exit holes; and
- the dominant vegetation that is associated with the elderberry shrub or shrub cluster.

The location of each elderberry shrub will be mapped using GPS, and a site map will be prepared identifying the location and size of each shrub and shrub cluster. DWR will use this site map to determine vehicle and equipment haul routes and work areas. Following completion of dredging activities DWR will perform a postconstruction evaluation of the elderberry shrubs to determine if any shrubs were damaged by construction activities. If damage occurs to elderberry shrubs, DWR will consult with USFWS on appropriate mitigation.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-MM-7: Avoid and Minimize Impacts on Elderberry Shrubs. Wherever feasible, DWR and Reclamation will avoid and minimize effects on elderberry shrubs. Avoidance and minimization efforts will be performed according to the USFWS VELB compensation guidelines (U.S. Fish and Wildlife Service 1999b). If elderberry shrubs with one or more stems measuring 1 inch or greater in diameter at ground level or plants with visible evidence of exit holes are located within or adjacent to proposed construction or dredging areas, DWR and Reclamation will implement the following actions:

- Install exclusion fencing around each elderberry shrub and shrub cluster.
- Avoid disturbance to VELB by establishing and maintaining, to the maximum extent feasible, a 100-foot buffer around elderberry plants identified as suitable habitat. If a 100-foot buffer cannot be maintained, DWR and Reclamation will consult and gain approval from the USFWS for measures that would minimize disturbance and promptly restore the damaged area.
- Fence and flag all buffer areas and place signs every 50 feet along the edge of the avoidance area, as described in the VELB compensation guidelines (U.S. Fish and Wildlife Service 1999b).
- Train construction personnel to recognize elderberry shrubs and to determine the presence of VELB from exit holes on stems. All construction personnel should receive USFWS–approved environmental awareness training prior to undertaking work at construction sites.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-MM-8: Compensate for Unavoidable Impacts on Elderberry Shrubs. If avoidance and minimization of effects on VELB habitat are not possible, DWR and Reclamation will compensate for unavoidable effects based on the VELB conservation guidelines (U.S. Fish and Wildlife Service 1999b). Mitigation efforts may include transplanting elderberry shrubs, planting additional elderberry and associated plant species at an on-site or off-site mitigation area, or purchasing VELB mitigation credits at a USFWS–approved mitigation bank.

This mitigation measure is consistent with CALFED Mitigation Measures 2, 5, 12, 16, 22, and 27.

Impact WILD-9: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Effects on Swainson's hawk include the loss or disturbance of active nests and the loss or disturbance of foraging habitat. Noise and visual disturbances associated with operation of equipment and other construction- and maintenance-related activities within up to ½ mile of occupied nest sites could adversely affect nesting Swainson's hawks. Noise and visual disturbances of sufficient magnitude could result in the nest abandonment, a reduction in the level of care provided by adults (e.g., duration of brooding, frequency of feeding), or forced fledging. If these situations occur, it could result in reducing the likelihood for successful production of young during the year of disturbance. The number of nests or young that could be affected will be determined annually during the preconstruction surveys and active construction period surveys, as described below.

Nest-site removal or disturbance will occur only if Swainson's hawks are nesting at the time the trees are removed or the area around the nest is disturbed by these activities. Because Swainson's hawk nest sites may vary from year to year, the number of nest sites that could be affected by the project may vary annually. Preconstruction surveys will be performed throughout the spring months to determine whether nest sites are located within ½ mile of proposed project activities.

Approximately 0.03 acre of riparian woodland, which provides nesting habitat for Swainson's hawk, would be affected by gate construction. Riparian woodland at the gate sites occurs on the in-channel island at the Grant Line gate site. Approximately 0.06 acre of riparian woodland would be affected by channel dredging. Siphon extension is not expected to affect riparian habitat. Swainson's hawk nests have been observed in the vicinity of the gate sites; however, no nest sites were observed at the existing temporary barrier sites (i.e., the proposed permanent gate sites).

The temporary loss or disturbance of agricultural land could result in the temporary loss of Swainson's hawk foraging habitat. The acreage of foraging habitat that is temporarily affected will be quantified once the footprints for the settling ponds and runoff management basins have been finalized. These temporary losses would not substantially reduce available foraging habitat for Swainson's hawk in the study area. The conversion of agricultural land to gate site facilities would result in the permanent loss of approximately 7.55 acres of agricultural land.

The potential loss or disturbance of nesting Swainson's hawk from channel dredging is considered significant because these actions could affect the nesting success of a special-status species. Settling basins associated with channel dredging would result in the temporary loss of up to 165 acres of foraging habitat.

The temporary and permanent disturbance to agricultural lands is considered significant. Although the loss of foraging habitat is relatively small compared to the total suitable foraging habitat in the study area, DFG requires compensation for loss of foraging habitat in the vicinity of active Swainson's hawk nest. Implementation of Mitigation Measures WILD-MM-1, WILD-MM-3, WILD-MM-9, WILD-MM-10, WILD-MM-11, and WILD-MM-12 would reduce impacts on nesting and foraging habitat for Swainson's hawks to a less-than-significant level.

Mitigation Measure WILD-MM-9: Perform Preconstruction Surveys for Nesting Swainson's Hawks prior to Construction and Maintenance. Preconstruction surveys for Swainson's hawk will be conducted at and adjacent to all locations to be disturbed by gate construction, channel dredging, and spoils deposition to ensure that this species is not nesting in these locations. Surveys will also be performed at all mitigation sites prior to implementation of the mitigation features. Preconstruction surveys will consist of surveying all potential nest sites within ½ mile of proposed construction features, sediment removal areas, and mitigation sites. Surveys will be performed several times during the breeding season to avoid and minimize effects on late nesting birds. Nest sites will be marked on an aerial photograph, and the position will be recorded using GPS. This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-MM-10: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites. Portions of the gate construction would occur throughout the year and would overlap with the Swainson's hawk breeding season. To the greatest extent practicable, major construction activities that would occur within ½ mile of an active Swainson's hawk nest will be avoided during the breeding season. If practicable, construction or dredging activities that would result in the greatest disturbance to an active nest site will be deferred until after or as late in the breeding season as possible. DWR will provide the locations of active nest sites identified during the preconstruction surveys to DFG and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

DFG requires that a ½-mile buffer be established around all active Swainson's hawk nests between March 1 and August 15 (California Department of Fish and Game 1994). Potential nesting trees within the gate construction footprint will be removed prior to construction. Potential nest trees outside the construction footprint will be retained. Vegetation will be removed prior to the nesting season for migratory birds and Swainson's hawk (i.e., removal will occur between September 1 and February 1).

Because of the relatively narrow width of the project area and the location and dimensions of the proposed work areas and access roads to riparian vegetation that could provide nesting habitat for Swainson's hawk, a ½-mile buffer may not be feasible in all areas. DWR will maximize the buffer width around active nest sites on a site-by-site basis and will consult with DFG on the buffer widths before commencing construction activities. If possible, DWR will delay construction and maintenance around individual raptor nests until after the young have fledged. DWR will immediately cease work and contact DFG if a young bird has prematurely fledged the nest as a result of construction or maintenance activities.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Mitigation Measure WILD-MM-11: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat. To compensate for the loss of foraging habitat, DWR will mitigate the loss of Swainson's hawk foraging habitat, as required by DFG. Based on recorded nest site observations in the project area, it can be assumed that gate construction, sediment removal, and mitigation activities will occur within 1 mile of active nest sites. As a result, DWR shall provide mitigation for foraging habitat at one of the following ratios (California Department of Fish and Game 1994):

- Provide 1 acre of suitable foraging habitat (e.g.; Habitat Management [HM] lands) for each acre of affected habitat (1:1 ratio). At least 10% of these lands shall include a fee title acquisition or conservation easement allowing for active management of the land to manage for active prey production. The remaining 90% of the HM lands will be protected by a conservation easement on agricultural or other lands that provide suitable foraging habitat for Swainson's hawks; or
- Provide ½ acre of HM land, with a fee title acquisition or conservation easement allowing for active management of the land to manage for active prey production (0.5:1 ratio).

DWR will also provide funding to ensure that these lands will be managed to provide Swainson's hawk foraging habitat. This funding will consist of a site management endowment at a rate to be determined by DFG.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 5, 12, 16, 17, 22, 23, and 29.

Mitigation Measure WILD-MM-12: Avoid Removal of Occupied Nest Sites. As stated under WILD-MM-9, preconstruction surveys will be performed to identify active nest sites before implementing construction, dredging, or mitigation activities. DWR and Reclamation will remove suitable nest trees in locations where trees are scheduled for removal before the start of the nesting season. Additionally, before February 15 of each construction season, DWR and Reclamation will remove all suitable nesting habitat for migratory birds in areas where vegetation is scheduled to be cleared. Removal of vegetation before the nesting season will ensure that occupied nests are not removed. If construction, dredging, or mitigation activities require the removal of additional vegetation not previously designated for removal, DWR and Reclamation will perform clearance surveys to determine whether nesting hawks are present. If additional tree removal is required, it will be deferred until after the breeding season.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Impact WILD-10: Loss or Disturbance of San Joaquin Kit Fox or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Effects on San Joaquin kit fox include the loss or disturbance of active dens and the loss or disturbance of foraging habitat. Gate construction would result in the permanent loss of 3.2 acres of agricultural land in the vicinity of the Old River gate. These actions would not significantly affect denning or foraging habitat for the San Joaquin kit fox because the affected areas occur primarily in areas that are already subject to disturbance during placement and removal of the existing temporary barriers. Kit fox have not been observed at the gate sites during previous surveys performed by DWR. Temporarily disturbed areas will be reseeded following construction as stated under Impact WILD-5 (Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions).

Although this species is not expected to occur at the gate sites or channel dredging area, the kit fox has a relatively large home range and could be affected by gate construction. The potential for effects on kit fox is considered significant but would be reduced to a less-than-significant level following implementation of Mitigation Measures WILD-MM-13, WILD-MM-14, and WILD-MM-15.

Mitigation Measure WILD-MM-13: Perform Preconstruction Surveys for San Joaquin Kit Fox. Preconstruction surveys for kit fox will be conducted at and adjacent to all locations to be disturbed by gate construction to ensure that this species is not present in these locations. Preconstruction surveys will consist of surveying all potential denning habitat in the vicinity of proposed construction features, as well as along all haul roads located on levees. Because kit fox sightings are known within 10-miles of the project area, surveys will be performed according to USFWS guidelines (U.S. Fish and Wildlife Service 1999c). Surveys will include walking transects (at least one between May 1 and September 30), spotlighting surveys for 10 nights over a 15-day period, camera stations, and scent stations. The survey methods will be determined in coordination with USFWS.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-MM-14: Minimize Construction-Related Disturbances near Active Den Sites. If kit fox dens are found at the gate construction sites or along access roads, major construction and dredging activities that would result in the greatest disturbance to an active den site will be deferred until after or as late in the breeding season as possible. DWR will provide the locations of active den sites identified during the preconstruction surveys to USFWS and will coordinate with USFWS on appropriate avoidance and minimization measures on a case-by-case basis.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Mitigation Measure WILD-MM-15: Replace Lost San Joaquin Kit Fox Habitat. If it is determined that occupied habitat is present in the project area, DWR will implement one of the following actions, pending direction from USFWS:

1. acquire, protect, and manage 1–3 acres of existing occupied habitat for every acre within the same area of occupied habitat affected by the project; or
2. enhance or restore 1–3 acres of suitable habitat near affected areas for every acre of occupied habitat affected.

Based on known project effects (i.e., 3.2 total acres of agricultural lands), DWR will acquire, protect, or manage 3.2 acres of suitable kit fox habitat in the study area, or pending approval of USFWS, purchase mitigation or conservation bank credits at an approved bank.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 5, 12, 16, 17, 22, 23, and 29.

Impact WILD-11: Loss of Giant Garter Snake or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Construction in areas adjacent to irrigation ditches associated with agricultural land could cause direct mortality of, or remove habitat for, the giant garter snake. Direct impacts on individuals of this species could also occur during construction. Because the giant garter snake is a special-status species, this impact would be significant.

Implementation of Mitigation Measures WILD-MM-4, WILD-MM-16, and WILD-MM-17 would reduce this impact to a less-than-significant level.

Mitigation Measure WILD-MM-16: Conduct Preconstruction Surveys for Giant Garter Snake. Preconstruction surveys for giant garter snake will be conducted in all suitable breeding and foraging habitat in the vicinity of project or mitigation activities to ensure that this species is not present in these locations. Surveys will also be performed at all mitigation sites prior to implementation of the mitigation features. Surveys will be performed during the active period of the snake (May 1–October 1). If surveys must be conducted during the species inactive period, DWR will contact USFWS to determine whether additional measures are necessary to minimize and avoid take (U.S. Fish and Wildlife Service 1997). Preconstruction surveys will be performed by a qualified biologist within 24-hours of commencement of construction or dredging activities. The survey results will be provided to USFWS before starting construction activities.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-MM-17: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat. Gate construction and settling basin activities would occur throughout the year and would overlap the giant garter snake active and inactive periods. To the greatest extent practicable, major construction activities that would affect giant garter snake breeding and foraging habitat will be avoided during the active period. If project construction activities necessitate dewatering wetland habitat during the snake's active period, that habitat will remain dry for at least 15 consecutive days before excavation or refilling (U.S. Fish and Wildlife Service 1997). If construction activities will be conducted during the species' inactive period, DWR will contact USFWS to determine whether additional measures are necessary to minimize and avoid take.

Clearing of wetland vegetation will be confined to the minimal area necessary to complete the desired activities. The movement of heavy equipment will be restricted to established roadways or constructed haul roads to minimize habitat disturbance.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Impact WILD-12: Loss of Western Pond Turtle or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate construction, channel dredging, and siphon extension in areas within or adjacent to wetland and aquatic habitats, including tidal perennial aquatic, tidal emergent wetland, off-channel ponds, marshes, and irrigation ditches, could cause direct mortality of, or remove habitat for, western pond turtles.

Most habitat effects would be temporary because most of the affected habitats would be restored following gate installation. Permanent impacts would include all land within the footprint of the gate site and the extent of levee toes upstream and downstream of each gate where rock slope protection would be placed. Impacts on wetland vegetation may include the complete removal of vegetation as a result of channel bed excavation, cutting of vegetation, or the placement of fill material on existing wetlands. Impacts on individuals of this species could also occur during gate construction or channel dredging.

Because the western pond turtle is designated as a federal and state species of concern, this impact would be significant. Implementation of Mitigation Measures WILD-MM-4 and WILD-MM-18 would reduce this impact to a less-than-significant level.

Mitigation Measure WILD-MM-18: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat. Western pond turtles are known to occur in Middle River, Old River, and Grant Line Canal and are expected to occur in suitable off-channel habitats. Because these waterways are large, open systems, it is not feasible to clear and permanently exclude all western pond turtles from the gate construction sites. Preconstruction surveys will be conducted by a qualified biologist to determine the approximate population density of turtles in the construction areas. DWR will install sheetpiles, cofferdams, or other measures to minimize sedimentation between the in-channel construction zones and adjacent waterways at the gate sites. This system will minimize the degradation of aquatic habitats outside of the construction zone and inhibit the movement of some turtles into the construction zone. These measures will not be used at the channel dredging sites because these sites will be continually moving along the channels during the dredging process, and such measures would not be feasible. Turtles occurring within the work area will be captured and relocated to a nearby location outside of the work area.

To avoid the loss of western pond turtle and eggs as a result of construction, DWR will install plastic orange mesh exclusion fencing or silt exclusion fencing on the channel banks to prevent turtles from nesting in the work areas. The fencing will be installed to a depth of 6 inches below the ground surface to prevent turtles from going under the fence. Fences will be installed before the nesting season (i.e., March 1) and shall remain in place through August. The fencing may be removed prior to grading.

An on-site biologist will be present during all in-channel activities to relocate western pond turtles outside of construction zones.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Impact WILD-13: Loss or Disturbance of Raptor Nest Sites as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

The study area is known to provide nesting habitat for northern harriers, white-tailed kites, Cooper's hawk, and several other raptor species. Construction could result in loss or disturbance of raptor nests. Because disturbance of an active raptor nest would violate Sections 3503 and 3503.5 of the California Fish and Game Code, this impact is significant. Implementation of Mitigation Measures WILD-MM-2 and WILD-MM-3 would reduce this impact to a less-than-significant level.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate construction and channel dredging could result in loss or disturbance of tricolored blackbird nests or potential nesting habitat and the temporary loss of foraging habitat. Impacts on riparian scrub, tidal emergent wetland, agricultural land, and ruderal vegetation that provides potential nesting habitat are described above under Impacts WILD-2, WILD-3, and WILD-5. Permanent impacts on wetland and riparian scrub vegetation for the gate sites would include all land within the footprint of the gate site and the extent of levee toes upstream and downstream of each gate where rock slope protection would be placed. Impacts on wetland vegetation may include the complete removal of vegetation as a result of excavating channel beds, cutting vegetation, or the placing fill material on existing wetlands.

Because tricolored blackbirds are a federal and state species of concern, the loss of nests or potential nesting habitat is significant. The loss of foraging habitat is not considered significant because the ruderal habitats and agricultural lands in which this species may forage are abundant in the study area. For example, there are approximately 146,000 acres of agricultural lands (excluding orchards and vineyards) in the study area. The temporary loss of up to 165 acres of agricultural land for the settling basins represents a substantially small percent of the overall potential agricultural land foraging habitat for tricolored blackbirds.

Implementation of Mitigation Measures WILD-MM-1, WILD-MM-2, WILD-MM-3, WILD-MM-4, WILD-MM-19, and WILD-MM-20 would reduce this impact to a less-than-significant level.

Mitigation Measure WILD-MM-19: Conduct Preconstruction Surveys for Tricolored Blackbird. Preconstruction surveys for tricolored blackbird will be conducted at and adjacent to all locations to be disturbed by construction, channel dredging, and spoils deposition to ensure that this species is not nesting in these locations. Surveys will also be performed at all mitigation sites prior to implementation of the mitigation features.

Preconstruction surveys will consist of surveying all suitable breeding habitat in the vicinity of project or mitigation activities. Pedestrian survey transects will be used to provide 100% visual coverage of the suitable breeding habitat. Nest colony surveys are recommended to begin at the end of April with subsequent surveys occurring throughout the breeding season (Beedy and Hamilton 1997). If a nesting colony is observed, the location will be marked on an aerial photograph, and the position will be recorded using GPS.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-MM-20: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies. Portions of the gate construction and sediment removal activities would occur throughout year and would overlap the tricolored blackbird breeding season (mid-April–July). To the greatest extent practicable, major construction activities that occur within ¼ mile of tricolored blackbird nest sites will be avoided during the breeding season. If practicable, construction or dredging activities that would result in the greatest disturbance to an active nest sites will be deferred until after or as late in the breeding season as possible. DWR will provide the locations of active nest sites identified during the preconstruction surveys to DFG and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Impact WILD-15: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Construction in areas containing occupied burrowing owl burrows could cause direct mortality of nesting owls or nest abandonment. Gate construction activities affect 0.04 acre of ruderal vegetation and the placement of temporary settling basins for channel dredging will affect up to 47.40 acres of ruderal vegetation. Permanent impacts on ruderal vegetation for each gate site would include all land within the footprint of the gate and the extent of levee upstream and downstream of each gate where slope protection would be placed. Temporary impacts on ruderal vegetation would include temporary construction easements adjacent to the permanent impact areas and the dredge disposal areas. Impacts on ruderal vegetation may include the complete removal or cutting (e.g., mowing) of vegetation.

Because the burrowing owl is a federal species of concern and a state species of special concern, this impact is significant. Implementation of Mitigation Measures WILD-MM-2, WILD-MM-3, WILD-MM-21, WILD-MM-22, WILD-MM-23, WILD-MM-24, and WILD-MM-25 would reduce this impact to a less-than-significant level.

Mitigation Measure WILD-MM-21: Conduct Preconstruction Surveys for Burrowing Owls. Preconstruction surveys for western burrowing owls will be conducted at and adjacent to all locations to be disturbed by construction, channel dredging, and spoils deposition, to ensure that this species is not nesting or roosting in these locations. Surveys will also be performed at all mitigation sites prior to implementation of the mitigation features. Preconstruction surveys will be performed according to the DFG guidelines for this species (California Department of Fish and Game 1995b). Surveys will consist of surveying all suitable nesting and roosting habitat within 500 feet of proposed construction features, dredging and deposition areas, and mitigation sites, as well as along all haul roads located on levees or at the toe of the levees.

Surveys will be conducted during both the wintering and nesting seasons, unless the species is detected during the first survey. The winter survey will be conducted between December 1 and January 31 (if possible). Nesting surveys will be conducted between April 15 and July 15 to correspond with the peak of the breeding season. Surveys will be performed in the early morning and evening as specified in the DFG guidelines. Pedestrian survey transects will be spaced to provide 100% visual coverage of the ground surface. Disturbance of occupied burrows during the surveys will be avoided to the greatest extent practicable. In addition to the seasonal surveys, a preconstruction survey will be conducted within 30 days prior to construction to ensure that no additional owls have established territories since the initial surveys.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-MM-22: Minimize Construction-Related Disturbances near Occupied Nest Sites. Burrowing owls may use the nest burrows as roosting sites throughout the year or may move into other burrows not used for nesting outside of the breeding season. Major construction and dredging activities that would result in the greatest disturbance to an active nest or roost sites will be deferred until after or as late in the breeding season as possible.

The following activities are considered impacts on western burrowing owls (California Department of Fish and Game 1995b):

- disturbance within approximately 160 feet (50 meters), which may result in harassment of owls at occupied burrows;
- destruction of natural and artificial burrows; and
- destruction or degradation of foraging habitat within 330 feet (100 meters) of an occupied burrow.

DWR will provide the locations of occupied burrows identified during the preconstruction surveys to DFG and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Mitigation Measure WILD-MM-23: Avoid or Minimize Disturbance to Active Nest and Roost Sites. If practicable, active nest and roost sites will be avoided during project implementation. To avoid impacts during the nonbreeding season (September 1–January 31), no activities should occur within 160 feet of occupied burrows. To avoid impacts during the breeding season (February 1–August 31) no activities should occur within 250 feet of occupied burrows. Avoidance of occupied burrows also requires that a minimum of 6.5 acres of foraging habitat be permanently preserved around each occupied burrow (California Department of Fish and Game 1995b).

If active burrows are identified during the preconstruction surveys, DWR will coordinate with DFG to identify the appropriate avoidance and minimization measures and to determine the configuration of the foraging habitat to be permanently preserved.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Mitigation Measure WILD-MM-24: Mitigation of Impacts on Occupied Burrows. If the destruction of occupied burrows is unavoidable, existing unsuitable burrows will be enhanced or new burrows will be created in accordance with the DFG guidelines (California Department of Fish and Game 1995b). New or enhanced burrows will be provided at a ratio of 2:1 and located on lands that will be preserved and maintained by DWR. DWR will provide funding for the long-term management and monitoring of these lands and will prepare a monitoring plan for the burrowing owl mitigation site.

Passive relocation techniques will be used to clear burrowing owls from occupied burrows. These techniques are described in the DFG guidelines for this species. Passive relocation techniques and artificial burrow designs will be approved by DFG prior to implementing this mitigation measure. Passive relocation will not be allowed until after the breeding season if it is determined that eggs or nestlings are present.

This mitigation measure is consistent with CALFED Mitigation Measures 17 and 31.

Mitigation Measure WILD-MM-25: Replace Lost Burrowing Owl Foraging Habitat. If it is determined that occupied burrows are present in the project area, DWR will mitigate the loss or disturbance of foraging habitat by implementing the following measures:

1. Permanently preserve 6.5 acres of foraging habitat around each occupied burrow that is avoided. The 6.5 acres may include an approximately 300-foot radius around each burrow or an alternate configuration totaling 6.5 acres, as approved by DFG.
2. Permanently preserve 6.5 acres of foraging habitat around each newly constructed or enhanced burrow. The 6.5 acres may include an approximately 300-foot radius around each burrow or an alternate configuration totaling 6.5 acres, as approved by DFG.

Based on the preconstruction survey results, DWR will avoid and minimize impacts on burrowing owls and acquire, protect, or manage suitable burrowing owl foraging habitat in the project vicinity or, pending approval of DFG, purchase mitigation or conservation bank credits at an approved bank.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 5, 16, 17, 23, 29, and 31.

Impact WILD-16: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate construction could result in loss or disturbance of California black rail nests or potential nesting habitat. Impacts on tidal emergent wetland vegetation include permanent impacts (see Section 6.2, Vegetation and Wetlands). Permanent impacts on wetland vegetation for the gate sites would include all land within the footprint of the gate site and the extent of levee toes upstream and downstream of each gate where rock slope protection would be placed. Impacts on wetland vegetation may include the complete removal of vegetation as a result of excavating channel beds, cutting vegetation, or placing fill material on existing wetlands.

Because this species is a federal and state species of concern, and is a fully protected state species, this impact is significant. Implementation of Mitigation Measures WILD-MM-2, WILD-MM-3, WILD-MM-4, WILD-MM-26, and WILD-MM-27 would reduce this impact to a less-than-significant level.

Mitigation Measure WILD-MM-26: Conduct Preconstruction Surveys for California Black Rail. Preconstruction surveys for California black rail will be conducted at and adjacent to all locations to be disturbed by construction, channel dredging, and spoils deposition to ensure that this species is not nesting in these locations. Surveys will also be performed at all mitigation sites prior to implementation of the mitigation features. Preconstruction surveys will consist of surveying all suitable breeding habitat in the vicinity of project or mitigation activities.

Surveys will be performed to record species presence and density and abundance. Surveys will be performed in all tidal emergent wetlands that are greater than 0.5 hectare in total area and have shallow water or moist soil conditions (Arizona Game and Fish Department 2002). Fixed, permanent survey points will be selected and marked in the field and by using a GPS receiver. Surveys will be performed several times during the breeding season to avoid and minimize effects on late nesting birds. The surveys will be performed during periods of good weather (e.g., clear to cloudy skies, no precipitation, minimal wind). The survey points will be surveyed in either the early morning or evening. Morning surveys will begin within 30 minutes of sunrise and will be completed within 4 hours after sunrise. Evening surveys will begin 4 hours before sunset and be completed before dark (Arizona Game and Fish Department 2002). A recording of a black rail call will be played at varying intervals and records of responses will be recorded. The playback interval will follow the guidelines identified in the black rail monitoring protocol (Arizona Game and Fish Department 2002). If a response is heard, the location will be marked on an aerial photograph, and the position will be recorded using GPS.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-MM-27: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites. Portions of the gate construction and dredging activities would occur throughout year and would overlap the California black rail breeding season (mid-March–July). To the greatest extent practicable, major construction activities that would be near expected California black rail nest sites will be avoided during the breeding season. If practicable, construction or dredging activities that would result in the greatest disturbance to an active nest site will be deferred until after or as late in the breeding season as possible. DWR will provide the locations of active nest sites identified during the preconstruction surveys to DFG and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Impact WILD-17: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands

The removal of agricultural land as a result of gate construction and channel dredging would result in the permanent and temporary loss of sandhill crane foraging habitat. This loss would have a relatively minor effect on sandhill crane because agricultural land is common throughout the study area and sandhill cranes are not expected to occur in the project area. Most of the impact on agricultural lands would be temporary and most of the disturbed area, except for the gate footprint and runoff management basins, would be restored following construction. The effect on greater sandhill crane from loss of agricultural land during construction and maintenance of the gate sites is considered less than significant.

No mitigation is required.

Impact WILD-18: Potential for Adverse Effects on Common Wildlife Species and Wildlife Habitat Associated with Gate Operations

Under Alternatives 2A–2C, gate operation is not expected to have a significant impact on wildlife or wildlife habitat.

Because the tidal range during operation of the gates would not change substantially from existing conditions, gate operation would not be expected to have a significant impact on the tidal emergent wetland or riparian vegetation (refer to Section 6.2, Vegetation and Wetlands).

These elevation changes are relatively minor and are not expected to adversely affect existing land cover types in the project area. Upstream vegetation adjacent to the channels would tolerate longer periods of inundation, and downstream vegetation could potentially spread into the new lower tide elevation. Because the high tide during project operations would not substantially change from existing conditions and low tide changes would not be expected to significantly affect vegetation, gate operation would not be expected to have a significant impact on the wildlife habitat (i.e., riparian, tidal emergent wetland, and tidal perennial aquatic). This impact is less than significant. No mitigation is required.

2020 Conditions

The impacts on wildlife resulting from operation of Alternatives 2A–2C under 2020 conditions would be similar to those described above under Alternative 1 (No Action Alternative). The same mitigation would apply.

Stage 2 (Operational Component)

Diversions of 8,500 cfs to CCF is not anticipated to result in noticeable changes beyond those described under Stage 1. There would be no additional impacts associated with implementation of Stage 2, and no mitigation is required.

2020 Conditions

The impacts on wildlife resulting from operation of Alternatives 2A–2C under 2020 conditions would be similar to those described above under Alternative 1 (No Action Alternative). The same mitigation would apply.

Interim Operations

Interim operations in south Delta would have similar effects on south Delta waterways and north- and south-of-Delta storage facilities. Therefore, the impacts on wildlife and wildlife habitat in these areas would be similar to those described for permanent operations of the SDIP. The same mitigation would apply.

Alternative 3B

Stage 1 (Physical/Structural Component)

Under Alternative 3B, the effects of the structural and physical components and channel dredging on wildlife resources are similar to those discussed under Alternatives 2A–2C. The only difference is that the Grant Line Canal gate would not be constructed under this alternative. The fish control gate at the head of Old River and the flow control gates in Old River and Middle River would be constructed in the same locations and in the same manner as discussed under Alternatives 2A–2C.

Impact WILD-2: Loss of Riparian-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate Construction. Under Alternative 3B, impacts on approximately 0.17 acre of riparian habitat from construction-related activities at the Middle River and Old River at DMC flow control gate sites would result in the reduction of riparian habitat area and values in the project area (Table 6.3-7). For the purpose of this evaluation for Alternative 3B, riparian habitat is composed of the riparian scrub and willow scrub land cover types. No riparian habitat is present at the head of Old River fish control gate site.

The loss of riparian habitat as a result of gate construction would also result in fragmentation of existing riparian habitats. Although some of the existing riparian vegetation is fragmented and composed of disjunct patches of vegetation that is separated by the temporary barriers, loss or further fragmentation of riparian habitat in the vicinity of the permanent gate sites is considered to be significant.

Channel Dredging. The effects of channel dredging at the three channel dredging sites under Alternative 3B would be the same as those described under Alternatives 2A–2C.

Siphon Extensions. Siphon extensions are not expected to result in effects on riparian habitat.

The permanent loss of up to 0.17 acre of woody riparian vegetation as a result of gate construction and the temporary loss of to 0.06 acre of woody riparian vegetation as a result of channel dredging would be considered a significant impact because it would result in the loss of woody riparian vegetation and a reduction in the extent of riparian communities, which are rare natural communities. Implementation of the mitigation measures listed below would reduce this impact to a less-than-significant level.

Implementation of the Mitigation Measures WILD-MM-1, WILD-MM-2, and WILD-MM-3 would reduce this impact to a less-than-significant level.

Impact WILD-3: Loss of Tidal Emergent Wetland–Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate Construction. Under Alternative 3B, impacts on approximately 0.08 acre of tidal emergent wetland habitat from construction- and operations-related activities at the gate sites would result in the reduction in wetland habitat area and values in the study area (Table 6.3-7). Wetland habitat that would be affected occurs primarily at the Middle River flow control gate site, and less than 0.01 acre would be affected at the Old River at DMC gate site. These wetlands are relatively small patches (Figure 6.2-5). No tidal emergent wetland habitat is present at the head of Old River fish control gate site.

Removal of tidal emergent wetland vegetation would result in the loss of foraging, breeding, and roosting habitat for common wildlife species in the study area. The loss of tidal emergent wetland habitat would not result in significant fragmentation of existing tidal emergent wetland habitat because these habitats are relatively fragmented under existing conditions, being composed of patches of vegetation. Although some of the existing wetland vegetation is fragmented and composed of disjunct patches of vegetation that are separated by the temporary barriers, loss or further fragmentation of wetland habitat in the vicinity of the permanent gate sites is considered to be significant.

Channel Dredging. The effects of channel dredging at the three channel dredging sites under Alternative 3B would be the same as those described under Alternatives 2A–2C.

Siphon Extensions. The effects of channel dredging at the siphon extension sites under Alternative 3B would be the same as those described under Alternatives 2A–2C.

The permanent impact on up to 0.08 acre of tidal emergent wetland under Alternative 3B would be considered a significant impact because the wetland is a water of the United States and is regulated under Section 404 of the CWA. These activities would result in reducing the amount of a sensitive natural community on which wildlife species in the study area depend for foraging,

Table 6.3-7. Land Cover Impacts Associated with Gate Construction and Dredging—Alternative 3B

	Acreages Affected by Gate Construction			Total Permanent Impacts Associated with Gate Construction	Acreages Affected by Dredging[1]				Total Temporary Impacts Associated with Dredging	Temporary Impacts Associated with Agricultural Diversions	Permanent Impacts Associated with Agricultural Diversions	Impacts Associated with Dredge Material Disposal [4]
Land Cover Type	Middle River Flow Control Gate	Old River at DMC Flow Control Gate	Head of Old River Fish Gate		Gate Sites	West Canal Conveyance Dredging Area	Middle River Conveyance Dredging Area	Old River Conveyance Dredging Area				
Tidal perennial aquatic	0.16	0.26	0.14	0.56	19.42	73.02	72.67	123.46	288.57	0.06	<0.01	0
Tule and cattail tidal emergent wetland	0.07	<0.01	0	<0.08	0	0	0	0	0	0	0	0
Cottonwood-willow woodland	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Cottonwood-willow woodland wetland	0	0	0	0		–[2]	–[2]	–[2]	<0.06[2]			0
Valley oak riparian woodland	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub	0	0	0	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub wetland	0.02	0.12	0	0.14		–[2]	–[2]	–[2]	<0.06[2]			0
Willow scrub	0	0.3	0	0.3	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Willow scrub wetland	0	0	0	0		–[2]	–[2]	–[2]	<0.06[2]			0
Agricultural land	0.50	2.00	0	2.50	3.60 [3]	0	0	0	0	0	0	101.50
Ruderal	0	0	0.02	0.02	0	0	0	0	0	0	0	47.40

DMC = Delta-Mendota Canal.

[1] Dredge impacts assumed impacts on all tidal perennial aquatic habitat within the dredge area. Actual loss of tidal perennial aquatic habitat will probably be less as a result of confining dredge activities to the center of the channel.

[2] Dredge impacts on individual riparian land cover types are not yet determined because the exact placement of the stationary pipes has not been identified. The riparian impact will total up to 0.06 acre at the three dredge areas.

[3] The acreage for the gate site agricultural impact includes the areas used for dredge drying areas at all three gate sites, which was assumed to require 1.2 acres at each site. This represents a permanent impact.

[4] The acreage for dredge drying areas at the 3 conveyance dredging areas is a temporary impact.

breeding, and roosting. Implementation of the mitigation below would reduce this impact to a less-than-significant level.

Implementation of the Mitigation Measures WILD-MM-2, WILD-MM-3, and WILD-MM-4 would reduce this impact to a less-than-significant level.

Impact WILD-4: Loss of Tidal Perennial Aquatic–Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, permanent and temporary impacts on approximately 19.98 acres of tidal perennial aquatic habitat from construction- and maintenance-related activities at the flow control gate sites would result in a reduction in tidal perennial aquatic habitat area and values in the study area (Table 6.3-7). Tidal perennial aquatic habitat would be affected at each of the gate sites. Project effects on tidal perennial aquatic habitat include permanent and temporary effects. Permanent effects would include the permanent loss of 0.56 acre of tidal perennial aquatic habitat in the gate footprint. Temporary effects would include the temporary loss of 19.42 acres of tidal perennial aquatic habitat in the construction and gate dredging zone.

Channel dredging and siphon extension effects and mitigation measures would be the same as those identified under Alternatives 2A–2C.

Permanent loss of up to 0.56 acre of tidal perennial aquatic habitat would be a significant impact. Implementation of Mitigation Measures WILD-MM-3 and WILD-MM-5 would reduce this impact to a less-than-significant level. No mitigation would be required for the temporary disturbance of tidal perennial aquatic habitat resulting from channel dredging.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Temporary disturbance of agricultural land and ruderal habitat would occur during construction of the gate, channel dredging, and siphon extension construction. Temporary disturbance would occur as a result of any dewatering activities required for gate construction, as well as work in the channel associated with dredging and placement of additional siphon pipeline. The effects of gate construction, channel dredging, and siphon extensions are described below.

Gate Construction. Construction at the three gate sites would result in the removal of up to 2.50 acres of agricultural land and 0.02 acre of ruderal vegetation. Impacts on agricultural land include 2.0 acres at the Old River at DMC gate site and 0.50 acre at the Middle River gate site.

Channel Dredging. A total of 3.60 acres of agricultural land, approximately 1.2 acres of agricultural land at each gate site, would be permanently lost for construction of disposal settling ponds or runoff management basins associated with gate site dredging.

Conveyance dredging and siphon extension impacts and mitigation measures would be the same as those identified under Alternatives 2A–2C.

The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the project area. No mitigation is required because implementation of environmental commitments (see Chapter 2) and Mitigation Measures WILD-MM-2 and WILD-MM-3 from above would restore the preproject habitat values of these sites following the completion of construction and dredging activities.

Potential effects on special-status species from the loss of agricultural land and ruderal habitat, as well as associated mitigation measures, are described below under the sections related to individual species.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

The potential for temporary disturbance and possible mortality to common wildlife species is described under Alternatives 2A–2C. The potential effects under Alternative 3B would be the same as those identified for Alternatives 2A–2C.

The potential for temporary disturbance and possible mortality to common wildlife species is considered less than significant because temporary and periodic use of heavy equipment would not substantially change the amount of disturbance currently occurring in the area, vegetation protection measures will be incorporated as an environmental commitment, and preconstruction surveys will be performed prior to commencing construction activities. Daily operation of the gates is not expected to disturb or cause mortality to wildlife.

No mitigation is required.

Impact WILD-7: Disruption of Wildlife Movement Corridors as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

The potential for disruption of movement corridors for common wildlife species from gate construction is described above under Alternatives 2A–2C. This potential effect is considered less than significant because most terrestrial wildlife species will be able to move around the gate.

No mitigation is required.

Impact WILD-8: Loss of Valley Elderberry Longhorn Beetle or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, the potential effects on VELB habitat from gate construction, channel dredging, and siphon extension are described above in Impact WILD-8, under Alternatives 2A–2C above. These potential effects on

VELB habitat are considered significant. Implementation of Mitigation Measures WILD-MM-6, WILD-MM-7, and WILD-MM-8 would reduce these effects to less than significant.

Impact WILD-9: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, potential effects on Swainson's hawk include the permanent and temporary loss of foraging habitat and construction-related disturbance to nesting Swainson's hawks. No riparian woodland, which provides potential nesting habitat for Swainson's hawk, would be affected under Alternative 3B. Swainson's hawk nests have been observed in the vicinity of the gate sites; however, no known nests sites were observed at the gate sites.

Temporary disturbance of agricultural land adjacent to the gate construction sites and associated access roads could result in temporary loss of Swainson's hawk foraging habitat. These temporary losses would not substantially reduce available foraging habitat for Swainson's hawk in the study area. The conversion of agricultural land to gate site facilities would result in the permanent loss of approximately 6.10 acres of agricultural land.

The loss of suitable nesting habitat and the potential disturbance of nesting Swainson's hawk during the construction phase of the project are considered significant. The temporary and permanent loss of foraging habitat is not expected to affect the value of these forage areas for Swainson's hawk because the affected areas would be small in comparison to overall foraging habitat available for this species in the study area. Although the loss of foraging habitat is relatively small, DFG requires compensation for loss of foraging habitat in the vicinity of active Swainson's hawk nests. Therefore, the temporary and permanent disturbance to agricultural lands is considered significant.

Implementation of Mitigation Measures WILD-MM-1, WILD-MM-2, WILD-MM-3, WILD-MM-9, WILD-MM-10, WILD-MM-11, and WILD-MM-12 would reduce impacts on nesting and foraging habitat for Swainson's hawks to a less-than-significant level.

Impact WILD-10: Loss or Disturbance of San Joaquin Kit Fox or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, effects on San Joaquin kit fox include the loss or disturbance of active dens and the loss or disturbance of foraging habitat. Gate construction would result in the permanent loss of 3.2 acres of agricultural land in the vicinity of the Old River gate. These actions would not significantly affect denning or foraging habitat for the San Joaquin kit fox because the affected areas occur primarily in areas that are already subject to disturbance during placement and removal of the existing temporary barriers. Kit fox have not been observed at the gate sites during previous surveys performed by DWR. Temporarily disturbed areas will be reseeded following construction as stated under Impact

WILD-5 (Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions).

Although this species is not expected to occur at the gate sites or channel dredging area, the kit fox has a relatively large home range and could be affected by gate construction. The potential for effects on kit fox is considered significant but would become less than significant following implementation of the Mitigation Measures WILD-MM-13, WILD-MM-14, and WILD-MM-15.

Impact WILD-11: Loss of Giant Garter Snake or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, construction in areas adjacent to irrigation ditches associated with agricultural land could cause direct mortality of, or remove habitat for, the giant garter snake. Direct impacts on individuals of this species could also occur during construction. Because the giant garter snake is a federal and state special-status species, this impact would be significant.

Implementation of Mitigation Measures WILD-MM-4, WILD-MM-16, and WILD-MM-17 would reduce this impact to a less-than-significant level.

Impact WILD-12: Loss of Western Pond Turtle or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, gate construction, channel dredging, and siphon extension in areas within or adjacent to wetland and aquatic habitats, including tidal perennial aquatic, tidal emergent wetland, off-channel ponds, marshes, and irrigation ditches, could cause direct mortality of, or remove habitat for, western pond turtles.

Most habitat effects would be temporary because most of the affected habitats would be restored following gate installation. Permanent impacts would include all land within the footprint of the gate site and the extent of levee toes upstream and downstream of each gate where rock slope protection would be placed. Impacts on wetland vegetation may include the complete removal of vegetation as a result of channel bed excavation, cutting of vegetation, or the placement of fill material on existing wetlands. Impacts on individuals of this species could also occur during gate construction or channel dredging. Impacts on tidal perennial aquatic habitat and tidal emergent wetland that provide potential habitat are described above under Impacts WILD-3 and WILD-4 for Alternative 3B.

Because the western pond turtle is designated as a federal and state species of concern, this impact would be significant. Implementation of Mitigation Measures WILD-MM-4 and WILD-MM-18 would reduce this impact to a less-than-significant level.

Impact WILD-13: Loss or Disturbance of Raptor Nest Sites as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

The study area is known to provide nesting habitat for northern harriers, white-tailed kites, Cooper's hawk, and several other raptor species. Construction could result in loss or disturbance of raptor nests. Because disturbance of an active raptor nest would violate Sections 3503 and 3503.5 of the California Fish and Game Code, this impact is significant. Implementation of Mitigation Measures WILD-MM-2 and WILD-MM-3 would reduce this impact to a less-than-significant level.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, gate construction and channel dredging would result in the loss of tidal emergent wetland, riparian scrub, agricultural lands, and ruderal vegetation. These impacts could result in the loss or disturbance of tricolored blackbird nests or potential nesting habitat and the temporary loss of foraging habitat. Impacts on riparian scrub, tidal emergent wetland, agricultural land, and ruderal vegetation that provide potential nesting habitat are described above under Impacts WILD-2, WILD-3, and WILD-5 for Alternative 3B. Permanent impacts on wetland and riparian scrub vegetation for the gate sites would include all land within the footprint of the gate site and the extent of levee toes upstream and downstream of each gate where rock slope protection would be placed. Impacts on wetland vegetation may include the complete removal of vegetation as a result of excavating channel beds, cutting vegetation, or placing fill material on existing wetlands.

Because tricolored blackbirds are a federal and state species of concern, this impact is significant. Implementation of Mitigation Measures WILD-MM-1, WILD-MM-2, WILD-MM-3, WILD-MM-4, WILD-MM-19, and WILD-MM-20 would reduce this impact to a less-than-significant level.

Impact WILD-15: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, construction in areas containing occupied burrowing owl burrows could cause direct mortality of burrowing owls or disturb nesting birds, which could result in nest abandonment. Impacts on ruderal vegetation that provides potential habitat are described above under Impact WILD-5 for Alternative 3B. Because the burrowing owl is a federal species of concern and a state species of special concern, this impact is significant. Implementation of Mitigation Measures WILD-MM-2, WILD-MM-3, WILD-MM-21, WILD-MM-22, WILD-MM-23, WILD-MM-24, and WILD-MM-25 would reduce this impact to a less-than-significant level.

Impact WILD-16: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 3B, construction would result in loss of tidal emergent wetland habitat and the loss or disturbance of California black rail nests or potential nesting habitat. Impacts on tidal emergent wetland are described above under Impact WILD-3 for Alternative 3B. Because this species is a federal and state species of concern, this impact is significant. Implementation of Mitigation Measures WILD-MM-2, WILD-MM-3, WILD-MM-4, WILD-MM-26, and WILD-MM-27 would reduce this impact to a less-than-significant level.

Impact WILD-17: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands

The removal of agricultural land would result in the temporary loss of wildlife foraging, breeding, and roosting habitat. This loss would have a relatively minor effect on wildlife because this land cover type is not considered a sensitive natural community and is common throughout the study area. Most of the impact on agricultural lands would be temporary and most of the disturbed area, except for the gate footprint and runoff management basins would be restored following construction.

The effect on greater sandhill crane from loss of agricultural land during construction and maintenance of the gate sites is considered a less-than-significant impact.

No mitigation is required.

Impact WILD-18: Potential for Adverse Effects on Common Wildlife Species and Wildlife Habitat Associated with Gate Operations

Under Alternative 3B, gate operation is not expected to have a significant impact on wildlife or wildlife habitat.

Because the tidal range during operation of the gates would not change substantially from existing conditions, gate operation would not be expected to have a significant impact on the tidal emergent wetland or riparian vegetation (refer to Section 6.2, Vegetation and Wetlands).

These elevation changes are relatively minor and are not expected to adversely affect existing land cover types in the project area. Upstream vegetation adjacent to the channels would tolerate longer periods of inundation, and downstream vegetation could potentially spread into the new lower tide elevation. Because the high tide during project operations would not substantially change from existing conditions and low tide changes would not be expected to significantly affect vegetation, gate operation would not be expected to have a significant impact on the wildlife habitat (i.e., riparian, tidal emergent wetland, and tidal perennial aquatic). This impact is less than significant. No mitigation is required.

2020 Conditions

The impacts on wildlife resulting from operation of Alternative 3B under 2020 conditions would be similar to those described above. The same mitigation would apply.

Stage 2 (Operational Component)

Diversions of 8,500 cfs to CCF is not anticipated to result in noticeable changes beyond those described under Stage 1. There would be no additional impacts associated with implementation of Stage 2, and no mitigation is required.

2020 Conditions

The impacts on wildlife resulting from operation of Alternative 3B under 2020 conditions would be similar to those described above. The same mitigation would apply.

Alternative 4B

Stage 1 (Physical/Structural Component)

Under Alternative 4B, the only gate to be constructed would be the fish control gate at the head of Old River. Dredging of south Delta channels would be the same as described under Alternatives 2A–2C. As a result, the impacts and mitigation measures for dredging under Alternative 4B would be the same as those identified above for Alternatives 2A–2C.

Impact WILD-2: Loss of Riparian-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate Construction. Under Alternative 4B, there would be no effect on riparian habitat because there is no riparian habitat present at the proposed location for the head of Old River fish control gate.

Channel Dredging. The effects of channel dredging head of Old River fish control gate under Alternative 4B would be the same as those described under Alternatives 2A–2C.

Siphon Extensions. Siphon extensions are not expected to result in effects on riparian habitat.

The temporary loss of up to 0.06 acre of woody riparian vegetation as a result of channel dredging would be less than significant because the areas would be small inclusions that would be allowed to revegetate with volunteers from adjacent riparian vegetation after construction and dredging are completed.

Implementation of Mitigation Measures WILD-MM-1, WILD-MM-2 and WILD-MM-3 would ensure that this impact is maintained at a less-than-significant level.

Impact WILD-3: Loss of Tidal Emergent Wetland–Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Gate Construction. Under Alternative 4B, there would be no effect on tidal emergent wetland habitat because there is no wetland habitat present at the proposed location for the head of Old River fish control gate.

Channel Dredging. The effects of channel dredging at the three channel dredging sites under Alternative 4B would be the same as those described under Alternatives 2A–2C.

Siphon Extensions. The effects of channel dredging at the siphon extension sites under Alternative 4B would be the same as those described under Alternatives 2A–2C.

No temporary or permanent impacts on tidal emergent wetland or jurisdictional riparian wetlands would occur under Alternative 4 because of the construction of the head of Old River fish control gate or dredging. No mitigation is required.

Impact WILD-4: Loss of Tidal Perennial Aquatic–Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, permanent and temporary impacts on approximately 7.72 acres of tidal perennial aquatic habitat from construction -related activities at the head of Old River fish control gate site would result in the reduction of open habitat area and values in the study area (Table 6.3-8). Project effects on tidal perennial aquatic habitat include permanent and temporary effects. Permanent effects would include the permanent loss of 0.14 acre of tidal perennial aquatic habitat in the gate footprint. Temporary effects would include the temporary disturbance of 7.58 acres of tidal perennial aquatic habitat within the gate construction zone and gate dredging area but outside of the permanent footprint of the gate. Areas of temporary effects have not been mapped or quantified.

Permanent loss of up to 0.14 acre of tidal perennial aquatic habitat would be a significant impact. Implementation of Mitigation Measures WILD-MM-3 and WILD-MM-5 would reduce this impact to a less-than-significant level. No mitigation would be required for the temporary disturbance of tidal perennial aquatic habitat resulting from channel dredging.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Temporary disturbance of agricultural land and ruderal habitat would occur during construction of the gate, channel dredging, and siphon extension construction. Temporary disturbance would occur as a result of any dewatering

Table 6.3-8. Land Cover Impacts Associated with Gate Construction and Dredging—Alternative 4B

Land Cover Type	Permanent Impacts Associated with Gate Construction	Acreages Affected by Dredging[1]				Total Temporary Impacts Associated with Dredging	Temporary Impacts Associated with Agricultural Diversions	Permanent Impacts Associated with Agricultural Diversions	Impacts Associated with Dredge Material Disposal[4]
		Head of Old River Fish Gate Site	West Canal Conveyance Dredging Area	Middle River Conveyance Dredging Area	Old River Conveyance Dredging Area				
Tidal perennial aquatic	0.14	7.58	73.02	72.67	123.46	276.73	0.06	<0.01	0
Tule and cattail tidal emergent wetland	0	0	0	0	0	0	0	0	0
Cottonwood-willow woodland	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Cottonwood-willow woodland wetland			–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Valley oak riparian woodland	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Riparian scrub wetland	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Willow scrub	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Willow scrub wetland	0	0	–[2]	–[2]	–[2]	<0.06[2]	0	0	0
Agricultural land	0	1.20[3]	0	0	0	0	0	0	101.50
Ruderal	0.02	0	0	0	0	0	0	0	47.40

Notes:

1 Dredge impacts assumed impacts on all tidal perennial aquatic habitat within the dredge area. Actual loss of tidal perennial aquatic habitat will probably be less as a result of confining dredge activities to the center of the channel.

2 Dredge impacts on individual riparian land cover types are not yet determined because the exact placement of the stationary pipes has not been identified. The riparian impact will total up to 0.06 acre at the three dredge areas.

3 The acreage for the gate site agricultural impact includes the area used for dredge drying areas at all the gate site, which was assumed to require 1.2 acres. This represents a permanent impact.

4 The acreage for dredge drying areas at the 3 conveyance dredging areas is a temporary impact.

activities required for gate construction, as well as work in the channel associated with dredging and placement of additional siphon pipeline. The effects of gate construction, channel dredging, and siphon extensions are described below.

Gate Construction. Construction at the head of Old River fish control gate would not result in the loss of agricultural land. Construction at the head of Old River gate would result in the permanent loss of 0.02 acre of ruderal vegetation.

Channel Dredging. A total of 1.20 acres of agricultural land would be permanently lost for construction of runoff management basins associated with gate site dredging.

Conveyance dredging and siphon extension impacts and mitigation measures would be the same as those identified under Alternatives 2A–2C.

The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the project area. No mitigation is required because implementation of environmental commitments (see Chapter 2) and Mitigation Measures WILD-MM-2 and WILD-MM-3 from above would restore the preproject habitat values of these sites following the completion of construction and dredging activities.

Potential effects on special-status species from the loss of agricultural land and ruderal habitat, as well as associated mitigation measures, are described below under the sections related to individual species.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

The potential for temporary disturbance and possible mortality to common wildlife species is described in detail under Alternatives 2A–2C above. The potential effects under Alternative 4B would be the same as those identified for Alternatives 2A–2C.

The potential for temporary disturbance and possible mortality to common wildlife species is considered less than significant because temporary and periodic use of heavy equipment would not substantially change the amount of disturbance currently occurring in the area, vegetation protection measures will be incorporated as an environmental commitment, and preconstruction surveys will be performed before starting construction activities. Daily operation of the gates is not expected to disturb or cause mortality to wildlife.

No mitigation is required.

Impact WILD-7: Disruption of Wildlife Movement Corridors as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

The potential for disruption of movement corridors for common wildlife species from gate construction is described above under Alternatives 2A–2C. The potential for disruption of movement corridors for common wildlife species is considered less than significant because most terrestrial wildlife species will be able to move around the gate.

No mitigation is required.

Impact WILD-8: Loss of Valley Elderberry Longhorn Beetle or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, the potential effects on VELB habitat from gate construction, channel dredging, and siphon extension are described above in Impact WILD-8, under Alternatives 2A–2C. These potential effects on VELB habitat are considered significant. Implementation of Mitigation Measures WILD-MM-6, WILD-MM-7, and WILD-MM-8 would reduce these effects to less than significant.

Impact WILD-9: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, potential effects on Swainson's hawk include construction-related disturbance to nesting Swainson's hawks. Approximately 0.06 acre of riparian woodland, which provides potential nesting habitat for Swainson's hawk, would be affected by channel dredging. Swainson's hawk nest have been observed in the vicinity of the gate sites; however, no known nests sites were observed at the gate sites.

The conversion of agricultural land to gate site facilities would result in the permanent loss of approximately 1.20 acres of agricultural land. Temporary disturbance of agricultural land adjacent to the gate construction sites and associated access roads could result in temporary loss of Swainson's hawk foraging habitat. These temporary losses would not substantially reduce available foraging habitat for Swainson's hawk in the study area.

The potential loss or disturbance of nesting Swainson's hawk from channel dredging is considered significant because these actions could affect the nesting success of a special-status species. Settling basins associated with channel dredging would result in the temporary loss of up to 165 acres of foraging habitat. The loss of suitable nesting habitat and the potential disturbance of nesting Swainson's hawk during the construction phase of the project are considered significant. The temporary and permanent loss of foraging habitat is not expected to affect the value of these forage areas for Swainson's hawk because the affected areas would be small in comparison to overall foraging habitat available for this species in the study area. Although the loss of foraging habitat is relatively small, DFG requires compensation for loss of foraging habitat in the vicinity of active Swainson's hawk nest. Therefore, the temporary and permanent disturbance to agricultural lands is considered significant.

Implementation of Mitigation Measures WILD-MM-1, WILD-MM-2, WILD-MM-3, WILD-MM-9, WILD-MM-10, WILD-MM-11, and WILD-MM-12 would reduce impacts on nesting and foraging habitat for Swainson's hawks to a less-than-significant level.

Impact WILD-10: Loss or Disturbance of San Joaquin Kit Fox or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, the potential effects on San Joaquin kit fox include the loss or disturbance of active dens and the loss or disturbance of foraging habitat from conveyance dredging in Old River. Temporarily disturbed areas will be reseeded following construction as stated under Impact WILD-5 (Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions).

Although this species is not expected to occur at the Old River channel dredging area, the kit fox has a relatively large home range and could be affected by channel dredging in this area. The potential for effects on kit fox is considered significant but would become less than significant following implementation of Mitigation Measures WILD-MM-13, WILD-MM-14, and WILD-MM-15.

Impact WILD-11: Loss of Giant Garter Snake or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, construction in areas adjacent to irrigation ditches associated with agricultural land could cause direct mortality of, or remove habitat for, the giant garter snake. Direct impacts on individuals of this species could also occur during construction.

Because the giant garter snake is a federally and special-status species, this impact would be significant. Implementation of Mitigation Measures WILD-MM-4, WILD-MM-16, and WILD-MM-17 would reduce this impact to a less-than-significant level.

Impact WILD-12: Loss of Western Pond Turtle or Suitable Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, gate construction, channel dredging, and siphon extension in areas within or adjacent to wetland and aquatic habitats, including tidal perennial aquatic, tidal emergent wetland, off-channel ponds, marshes, and irrigation ditches, could cause direct mortality of, or remove habitat for, western pond turtles.

Most habitat effects would be temporary because most of the affected habitats would be restored following gate installation. However, direct impacts on individuals of this species could occur during construction. Because the western pond turtle is designated as a federal and state species of concern, this impact would be significant. Implementation of Mitigation Measures WILD-MM-4 and WILD-MM-18 would reduce this impact to a less-than-significant level.

Impact WILD-13: Loss or Disturbance of Raptor Nest Sites as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

The study area is known to provide nesting habitat for northern harriers, white-tailed kites, Cooper's hawk, and several other raptor species. Construction could result in loss or disturbance of raptor nests. Because disturbance of an active raptor nest would violate Sections 3503 and 3503.5 of the California Fish and Game Code, this impact is significant. Implementation of Mitigation Measures WILD-MM-2 and WILD-MM-3 would reduce this impact to a less-than-significant level.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, gate construction and channel dredging would result in the loss of agricultural lands and ruderal vegetation. These impacts could result in the loss or disturbance of tricolored blackbird nests or potential nesting habitat and the temporary loss of foraging habitat. Impacts on agricultural land and ruderal vegetation that provide potential nesting habitat are described above under Impacts WILD-2, WILD-3, and WILD-5 for Alternative 4B.

Construction and dredging could result in loss or disturbance of tricolored blackbird nests or potential nesting habitat. Because tricolored blackbirds are a federal and state species of concern, this impact is significant. Implementation of Mitigation Measures WILD-MM-1, WILD-MM-2, WILD-MM-3, WILD-MM-4, WILD-MM-19, and WILD-MM-20 would reduce this impact to a less-than-significant level.

Impact WILD-15: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, construction in areas containing occupied burrowing owl burrows could cause direct mortality of burrowing owls or disturb nesting birds, which could result in nest abandonment. Impacts on ruderal vegetation that provides potential habitat are described above under Impact WILD-5 for Alternative 4B.

Because the burrowing owl is a federal species of concern and a state species of special concern, this impact is significant. Implementation of Mitigation Measures WILD-MM-2, WILD-MM-3, WILD-MM-21, WILD-MM-22, WILD-MM-23, WILD-MM-24, and WILD-MM-25 would reduce this impact to a less-than-significant level.

Impact WILD-16: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat as a Result of Gate Construction, Channel Dredging, and Siphon Extensions

Under Alternative 4B, construction and dredging would not result in loss of tidal emergent wetland habitat; however, it could result in the loss or disturbance of California black rail nests or potential nesting habitat.

Because this species is a federal and state species of concern, this impact is significant. Implementation of Mitigation Measures WILD-MM-2, WILD-MM-3, WILD-MM-4, WILD-MM-26, and WILD-MM-27 would reduce this impact to a less-than-significant level.

Impact WILD-17: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands

The removal of agricultural land would result in the temporary loss of wildlife foraging, breeding, and roosting habitat. This loss would have a relatively minor effect on wildlife because this land cover type is not considered a sensitive natural community and is common throughout the study area. Most of the impact on agricultural lands would be temporary, and most of the disturbed area, except for the gate footprint and runoff management basins would be restored following construction.

The effect on greater sandhill crane from loss of agricultural land during construction and maintenance of the gate sites is considered a less-than-significant impact. No mitigation is required.

Impact WILD-18: Potential for Adverse Effects on Common Wildlife Species and Wildlife Habitat Associated with Gate Operations

Under Alternative 4B, gate operation is not expected to have a significant impact on wildlife or wildlife habitat.

Because the tidal range during operation of the gates would not change substantially from existing conditions, gate operation would not be expected to have a significant impact on the tidal emergent wetland or riparian vegetation (refer to Section 6.2, Vegetation and Wetlands).

These elevation changes are relatively minor and are not expected to adversely affect existing land cover types in the project area. Upstream vegetation adjacent to the channels would tolerate longer periods of inundation, and downstream vegetation could potentially spread into the new lower tide elevation. Because the high tide during project operations would not substantially change from existing conditions and low tide changes would not be expected to significantly affect vegetation, gate operation would not be expected to have a significant impact on the wildlife habitat (i.e., riparian, tidal emergent wetland, and tidal perennial aquatic). This impact is less than significant. No mitigation is required.

2020 Conditions

The impacts on wildlife resulting from operation of Alternative 4B under 2020 conditions would be similar to those described above. The same mitigation would apply.

Stage 2 (Operational Component)

Diversions of 8,500 cfs to CCF is not anticipated to result in noticeable changes beyond those described under Stage 1. There would be no additional impacts associated with implementation of Stage 2, and no mitigation is required.

2020 Conditions

The impacts on wildlife resulting from operation of Alternative 4B under 2020 conditions would be similar to those described above. The same mitigation would apply.

Cumulative Evaluation of Impacts

Cumulative impacts on wildlife are analyzed in Chapter 10, “Cumulative Impacts.” This chapter also summarizes the other foreseeable future projects that may contribute to these impacts.