4.4 AQUATIC BIOLOGICAL RESOURCES

Issues & Supporting Information Sources	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the Project:				
a. Have a substantial adverse impact, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☒	☐
b. Have a substantial adverse impact on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☒	☐	☐
c. Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☒	☐	☐
d. Interfere substantially with the movement of any resident or migratory fish or wildlife species or with established resident or migratory wildlife corridors, or impede the use of wildlife nursery sites?	☐	☐	☒	☐
e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f. Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Communities Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

Note: Issues (b) and (c) are addressed in Section 4.5, Terrestrial Biological Resources.

4.4.1 Environmental Setting

4.4.1.1 Overview

The Project is located in the central Delta within and adjacent to the Old River and Connection Slough. The Delta comprises the estuary and associated islands, marsh and wetlands for the Sacramento and San Joaquin rivers. The Delta is one of the largest, most important estuarine systems for fish and waterfowl production on the Pacific Coast of the United States. This section addresses aquatic biological resources. Terrestrial biological resources are addressed in Section 4.5.

The Sacramento-San Joaquin Delta provides the habitats necessary to support a diverse assemblage of freshwater and estuarine species, many of them introduced. The fish fauna include resident and migratory fish. Resident fishes include native species such as delta smelt, longfin smelt, and Sacramento splittail, as well as introduced species such as catfish, largemouth bass, striped bass, crappie, and bluegill. Table 4.4-1 lists many of the typical fish species that use the Delta. The Delta's channels also serve as a migratory route and nursery area for Chinook salmon, steelhead trout, green sturgeon, white sturgeon, striped bass, and American shad. The Delta is a major rearing area for most of these species. The Delta habitats also support native and introduced species phytoplankton, zooplankton, and benthic macroinvertebrates. The aquatic ecosystem in the Delta has been highly modified by many factors including the construction of levees, channelization, introduced species, and water management activities (including local diversions and discharge and water transfers and exports). As a result of the combined modifications, declining population levels of several species have been identified as a concern.

Table 4.4-1 Typical Fish that Occupy the Delta

			Location	
Common Name	Scientific Name	Native	Delta	Central Valley Rivers
Lamprey (2 species}	*Lampetra spp.*	●	●	●
Chinook salmon	*Oncorhynchus tshawytacha*	●	●	●
Steelhead/rainbow trout	*Oncorhynchus mykiss*	●	●	●
White sturgeon	*Acipenser transmontanus*	●	●	●
Green sturgeon	*Acipenser medirostris*	●	●	●
Longfin smelt	*Spirinchus thaleichthys*	●	●	
Delta smelt	*Hypomesus transpacificus*	●	●	
Wakasagi	*Hypomesus nipponensis*		●	●
Sacramento sucker	*Catostomus occidentalis*	●	●	●
Sacramento pikeminnow	*Ptychocheilus grandis*	●	●	●
Splittail	*Pogonichthys macrolepidotus*	●	●	●
Sacramento blackfish	*Orthodon microlepidotus*	●	●	●
Hardhead	*Mylopharodon conocephalus*	●	●	●
Hitch	*Lavina exilicauda*	●	●	●
Golden shiner	*Notemigonus crysoleucas*		●	●
Fathead minnow	*Pimephales promelas*		●	●
Goldfish	*Carassius auratus*		●	●
Carp	*Cyprinus carpio*		●	●
Threadfin shad	*Dorosoma petenense*		●	●
American shad	*Alosa sapidissima*		●	●
Black bullhead	*Ictalurus melas*		●	●
Brown bullhead	*Ictalurus nebulosus*		●	●
White catfish	*Ictalurus catus*		●	●
Channel catftsh	*Ictalurus punctatus*		●	●
Mosquito fish	*Gambusia affinis*		●	●
Inland silverside	*Menidia audena*		●	●
Threespine stickleback	*Gasterosteus aculaetus*	●	●	●
Striped bass	*Morone saxatilis*		●	●
Bluegill	*Lepomis macrochirus*		●	●
Green sunfish	*Lepomis cyanellus*		●	●
Redear sunfish	*Lepomis microlophus*		●	●
Warmouth	*Lepomis gulosus*		●	●
White crappie	*Pomoxis annularis*		●	●
Black crappie	*Pomoxis nigromaculatus*		●	●
Largemouth bass	*Micropterus salmoides*		●	●
Spotted bass	*Micropterus punctulatus*		●	●
Smallmouth bass	*Micropterus dolomieui*		●	●
Bigscale logperch	*Percina macrolepida*		●	●
Yellowfin goby	*Acanthogobius flavimanus*		●	●
Chameleon goby	*Tridentiger trigonocephalus*		●	●
Prickly sculpin	*Coitus asper*	●	●	●
Tule perch	*Hysterocarpus traskii*	●	●	●

4.4.1.2 Critical Habitat

Under the federal ESA, the entire Delta has been designated as "critical habitat" for delta smelt, Central Valley steelhead, and green sturgeon and the Sacramento River along the north side of the Delta is designated as critical habitat for winter- and spring-run Chinook salmon. Critical habitat is defined in the ESA as the specific geographic area(s) that are essential to the conservation of a threatened or endangered species and that may require special management or protection. Critical habitat may include areas not currently occupied by the species but that are determined to be essential for its recovery. These areas have the physical and biological habitat features called "primary constituent elements" (PCEs) that species need to survive and reproduce. PCEs can include: cover or shelter; sites for reproduction and rearing of offspring; space for individual and population growth and normal behavior; migration corridors; and food, water and other nutritional or physiological requirements. Critical habitat designated for winter- (NMFS 1993) and spring-run Chinook salmon (NMFS 2005) does not include the Project sites. Critical habitat for Central Valley steelhead has been designated at the Project sites (NMFS 2005), principally as migration and juvenile rearing habitat. No designation has been made for Central Valley fall- or late fall-run Chinook salmon (federal species of concern) because critical habitat is designated only for federal threatened and endangered species. Critical habitat for delta smelt has been designated by USFWS at the Project sites. Critical habitat for the southern distinct population segment of North American green sturgeon was recently proposed by NMFS (2008) and includes the Project sites.

4.4.1.3 Essential Fish Habitat

Under the Magnuson-Stevens Fishery Conservation and Management Act, Essential Fish Habitat (EFH) is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC 1802[10]). The Pacific Fisheries Management Council (PFMC) designated EFH in their management plans. Two fishery management plans cover species that occur in the Project area and include the Delta as EFH. Chinook salmon are covered under the Pacific Coast Salmon Fisheries Management Plan. Freshwater EFH for Chinook salmon consists of four major habitat functions: (1) spawning and incubation, (2) juvenile rearing, (3) juvenile migration corridors, and (4) adult migration corridors and adult holding habitat. EFH includes those water bodies currently accessible (and in most cases, historically accessible) to fish. In the Delta near the Project area, EFH is designated for fall-run Chinook (adult migration and holding, juvenile migration, and possibly juvenile rearing) and late fall-run Chinook (intermittent adult holding or juvenile rearing). The Project area does not include EFH for winter-run or spring-run Chinook salmon, which pass to the north for spawning in the Sacramento Basin. Another species, the starry flounder (*Platichthys stellatus*), is covered under the Groundfish Management Plan; juveniles use the Delta as rearing habitat.

4.4.1.4 Phytoplankton

Phytoplankton are microscopic plants such as algae and diatoms that generally form the base of the aquatic food-chain. The recent trends in phytoplankton community structure and density have been identified as one of the concerns regarding the overall ecological health of the Delta (PPIC 2007, SWRCB 2008). These changes, as well as the collapse of several Delta fish populations, are being examined as part of the intensive Pelagic Organism Decline (POD) studies currently underway (Sommer et al. 2007, Baxter et al. 2008). Phytoplankton provide food for zooplankton (mostly copepods and cladocerans) and other pelagic (open water) and benthic (bottom-dwelling) herbivores. This food web is vital for the survival and growth of juvenile fish species. The decline in phytoplankton populations has been attributed to changes in water quality in the Delta and invasions of non-native planktivores, such as the overbite clam.

4.4.1.5 Zooplankton

Zooplankton are very small drifting animals, often crustaceans such as copepods, that inhabit the pelagic (open water) zone. Zooplankton are the primary consumers of phytoplankton in the Delta ecosystem, and are frequently the sole prey item for fish larvae of most species. Therefore, they are a key component in the estuarine food-chain supporting larger fish and macroinvertebrates. The community structure of Delta zooplankton has been significantly modified by introduced species.

4.4.1.6 Benthic and Epibenthic Macroinvertebrates

Benthic macroinvertebrates, such as polychaete and oligochaete worms, are bottom-dwelling animals that generally live within the top foot of sediment in the channel beds of the Delta, Epibenthic macroinvertebrates, such as shrimp, amphipods, crabs and bivalve mollusks, typically exist at the sediment surface. The distribution of these organisms is greatly influenced by water quality, substrate type and hydrologic conditions (e.g. flow velocity, salinity). Burgeoning populations of introduced bivalves, such as the overbite clam (*Corbula amurensis*) and the Asiatic clam (*Corbicula fluminea*), can strip zooplankton and phytoplankton from the water column and in some places have shifted the food web from a pelagic-based planktonic system to a benthic-based system (PPIC 2007, Baxter et al. 2008). Many other introduced species have displaced native macroinvertebrates.

4.4.1.7 Fish

Many fish species inhabit the Delta for all or some portion of their life history. These fish utilize a wide range of aquatic habitats in the Delta, including open water (pelagic), bottom (benthic), and nearshore shallow water habitat. Delta fishes exhibit a variety of feeding habits among different species and life stages (Moyle 2002). Many species forage on plankton (principally zooplankton), especially during the larval and juvenile life stages. As they mature, some species shift to become benthic predators (e.g., juveniles of splittail and sturgeon) or bottom-feeding omnivores (e.g., adult Sacramento splittail). Some species, such as striped bass, become piscivores as large adults. Other species, such as delta smelt and longfin smelt, remain planktivorous throughout their lives.

The fish community inhabiting the Delta is diverse and fluctuates within and between years as a result of local environmental and regional oceanic conditions. The present fauna in the Delta and Suisun Bay includes about 40 freshwater, estuarine, and euryhaline marine species (organisms that are able to adapt to a wide range of salinities), about half of them introduced (Moyle 2002).

4.4.1.8 Special-Status Aquatic Species

Special-status aquatic species are those species that are legally protected or otherwise considered sensitive by federal or state agencies. Such species are designated by the federal ESA and CESA or by the California Fish and Game Code section relating to fully-protected species.

Table 4.4-2 summarizes the special-status aquatic species expected to occur at the Project site. Table 4-4-3 provides a summary of federal aquatic species of concern and state aquatic species of special concern on the USFWS species list for the Brentwood quadrangle that have been collected during studies conducted in the area.

Table 4.4-2 Potentially Affected State and Federally Listed and State-Listed Aquatic Species

Common Name	Scientific Name	Listing Status[1]		Critical Habitat in Central Delta	Essential Fish Habitat
		Federal	State		
Delta smelt	*Hypomesus transpacificus*	FT	ST	Yes	N/A
Longfin smelt	*Spirinchus thaleichthys*		SE	N/A	N/A
North American green sturgeon	*Acipenser medirostris*	FE		Yes	
Sacramento River winter-run chinook salmon	*Oncorhynchus tshawytscha*	FE (proposed for downlisting to FT)	SE	No	Yes
Central Valley spring-run chinook salmon	*Oncorhynchus tshawytscha*	FT	ST	No	Yes
Central Valley steelhead	*Oncorhynchus mykiss*	FT	--	Yes	No
Central Valley fall/late fall-run chinook salmon	*Oncorhynchus tshawytscha*	FC	SSC	N/A	Yes

Source: Data compiled by Entrix in 2009 from NMFS, USFWS and CDFG

Note: Species list for the Brentwood quadrangle, which includes the Project site.
[1]Listing status definitions: FT = federally listed as threatened; FE = federally listed as endangered; FC = federal candidate; ST = state listed as threatened; SE = state listed as endangered; SSC = state species of concern, N/A = not applicable.

Table 4.4-3 Potentially Affected Federal and State Aquatic Species of Concern

Common Name	Scientific Name	Listing Status[1]	
		Federal	State
River lamprey[2]	*Lampetra ayresi*	FSC	SSC
Pacific lamprey[2]	*Lampetra tridentata*	FSC	SSC
Sacramento splittail	*Pogonichthys macrolepidotus*	FSC	--

Source: Data compiled by ENTRIX in 2009 from NMFS, USFWS and CDFG

Note: Species list for the Brentwood quadrangle, which contains the Project site.
[1] Listing status definitions: FSC = federal species of concern; SSC = state species of concern.
[2] Specimen reported as "lamprey" and not identified to species.

4.4.1.9 Biological Characteristic of Species of Greatest Concern

The following section provides a brief summary of the existing conditions for some of the aquatic species of greatest concern.

Delta Smelt

The delta smelt is endemic to the Sacramento-San Joaquin Delta, including Suisun Bay, but is generally most abundant in the western Delta and eastern Suisun Bay (Honker Bay) (Moyle et al. 1992). Distribution varies seasonally with freshwater outflow. Generally, the species inhabits areas where inflowing fresh water from the Delta system meets salt water from the Pacific Ocean via San Francisco Bay, usually upstream of the two parts per thousand (ppt) salinity concentration. Habitat for delta smelt is typically open water, largely away from shorelines and vegetated inshore areas except perhaps during spawning. Their behavior suggests a preference for low-salinity areas with tidal currents (Moyle 2002).

Delta smelt are planktivorous throughout their lives, feeding mainly on copepods, cladocerans and amphipods (Moyle et al. 1992, Bennett 2005). Individuals generally live about one year, although a small proportion of the population may live into its second year. The population of

delta smelt has declined substantially since the late 1970s. Since 2000, their populations have been at or near historic low values. One hypothesis for the decline of delta smelt and other pelagic species is food limitation, which may be due in part to introduced species of zooplankton (copepods) and consumers (clams) (Sommer et al. 2007).

The U.S. Fish and Wildlife Service (USFWS) listed the delta smelt as threatened effective April 5, 1993 (USFWS 1993). The delta smelt was listed as threatened by California Department of Fish and Game (DFG) on December 9, 1993. Critical habitat for delta smelt as defined by the USFWS (1994) encompasses Suisun Bay and the entire Delta. The primary constituent elements for delta smelt critical habitat include spawning habitat, larval and juvenile transport, rearing habitat, and adult migration. Because of the ongoing decline in the delta smelt indices, the species has been proposed for endangered status. The California Fish and Game Commission voted to list this species as endangered on March 4, 2009.

Longfin Smelt

The longfin smelt is a euryhaline (capable of tolerating a wide range of salinities), pelagic and anadromous species found in scattered bays and estuaries from California to Alaska (Moyle 2002). The Bay-Delta Estuary harbors the largest and southern-most self-sustaining population on the Pacific Coast. Longfin smelt are capable of living in freshwater, brackish, and marine environments over their two-year life-cycle. This population is at least partially anadromous, with adults migrating upstream from San Francisco Bay and sometimes the ocean to spawn in the Delta's freshwaters (Rosenfield and Baxter 2007).

Adult longfin smelt tend to aggregate in Suisun Bay and the western Delta in late fall, and then spawn in freshwater areas immediately upstream during winter and early spring. Longfin smelt eggs are adhesive and are probably released over a firm substrate (Moyle 2002). Longfin smelt larvae are buoyant and abundant in the upper portion of the water column usually from January through April. Larvae are frequently caught upstream of the Sacramento-San Joaquin River confluence in the Delta around Sherman Island (Baxter 1999, Dege and Brown 2004).

During their first year, juveniles disperse broadly throughout the western Delta around Sherman and Browns Islands towards Honker Bay. Rearing habitat for longfin smelt is typically open water, away from shorelines and vegetated inshore regions. Young juvenile longfin smelt feed primarily on copepods, while older juveniles and adult longfin smelt feed principally on opossum shrimp, *Neomysis americana, Acanthomysis* sp. and *Neomysis mercedis* when available (Hobbs et al. 2006). Adults and juveniles can be found in open waters of estuaries in the middle or near bottom of the water column (Moyle 2002). Maturity is reached at two years of age. Most longfin smelt live only two years; although females may live a third year, it is not certain if they spawn again.

Longfin smelt is not currently listed under the federal ESA; however, the species is listed under CESA as a species of special concern. Because the species is not listed, there is no designated critical habitat.

North American Green Sturgeon

Green sturgeon are among the largest of bony fishes, with a maximum fork length of 2.3 m and body weight of 159 kg (Moyle et al. 1992). They are slow-growing and long-lived (Emmett et al. 1991). The Sacramento River system has the southernmost reproductive population. Green sturgeon have not been documented using the San Joaquin River or its tributaries for spawning or rearing (DFG 2002).

Green sturgeon have always been uncommon within the Sacramento-San Joaquin River Delta (Moyle 2002) and reliable population estimates do not exist (Reclamation 2008). Green sturgeon juveniles are found throughout the Delta and San Francisco Bay, mostly in small numbers but sometimes in groups as large as one hundred fish as indicated by fish taken in trammel net sampling for DFG's white sturgeon assessments. Green sturgeon have also been taken in small boat trawls, striped bass sampling, and entrainment by water export facilities.

Spawning occurs well upstream in the Sacramento River from March to July, with a peak in mid-April to mid-June (Moyle et al. 1992). Little is known about larval rearing habitat requirements (NMFS 2008a). Juveniles rear in fresh and estuarine waters for about one to four years before dispersing into salt water (Nakamoto et al. 1995, NMFS 2008a). Adults and subadults primarily inhabit the Delta and bays during summer months, most likely for feeding and growth (Kelly et al. 2007, Moser and Lindley 2007), but also enter the Delta and bays during their spring migration to the Sacramento River and during their winter outmigration from the Sacramento River to the ocean (NMFS 2008a). This species spends the majority of its life in the ocean (Moyle et al. 1992).

Green sturgeon are highly adapted for preying on benthic organisms, which they detect with a row of extremely sensitive barbels on the underside of their snouts. Adults captured in the Sacramento-San Joaquin Delta are benthic feeders on invertebrates including shrimp, mollusks, amphipods, and even small fish (Houston 1988, Moyle et al. 1992). The non-native overbite clam (*Potamocorbula amurensis*) has also been found in green sturgeon (Adams et al 2002).

On September 8, 2008, NMFS proposed critical habitat for the Southern DPS (NMFS 2008b). The Delta is identified as an important area for juvenile feeding, rearing, and growth prior to ocean migration, as well as a migration corridor between the Sacramento River system and the ocean (NMFS 2008a).

Chinook Salmon

This section describes the existing conditions relating to Chinook salmon in the Delta. Two listed runs of Chinook salmon seasonally occur within the Project area: the federally endangered Sacramento River winter-run Chinook, and the federally threatened Central Valley spring-run Chinook. Two other salmon runs are combined in the analysis because of their similar life history patterns: the Central Valley fall-run Chinook salmon and the Central Valley late fall-run Chinook salmon. Only the adult and juvenile (parr and smolt) life stages of Chinook salmon occur in the Project area in the Delta. The differences between these runs are principally in the timing of adult and juvenile migrations through the Delta, and the timing and location of spawning (which occurs well upstream of the Delta). Life history information about juvenile rearing patterns in the Delta is considered generally applicable to all runs.

Winter-Run Chinook Salmon

The Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit (ESU) consists of a single population that is currently confined to spawning habitat below Keswick dam in the Sacramento River. The population utilizes rearing and migration habitats in the Sacramento River, Delta and San Francisco Bay, and the coastal waters of California.

Winter-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months (stream-type life history) (Myers et al. 1998, Healey 1991, Groot and Margolis 1991). Adults migrate through San Francisco Bay and the Delta from

November through June. Spawning occurs in the upper Sacramento River below Keswick dam from late-April through mid-August. Fry emerge mid-June through mid-October.

Winter-run juveniles emigrate into the Delta from October into June, with peak juvenile abundance generally from January to April. Distinct emigration pulses of both young-of-the-year (YOY) and yearling outmigrants appear to coincide with high precipitation and increased turbidity, which are correlated with high Sacramento River flows. Upon arrival in the Delta, winter-run Chinook salmon tend to rear in the more upstream freshwater portions of the Delta for about the first two months.

Within the Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels and sloughs (McDonald 1960, Dunford 1975). Juvenile Chinook salmon can follow the tidal cycle in their movements within the estuarine habitat, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levy and Northcote 1982, Levings 1982, Healey 1991). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982, Sommer et al. 2001, MacFarlane and Norton 2002). Shallow water habitats are reported to be more productive than the main river channels, supporting higher growth rates, due to more favorable environmental conditions and higher prey availability and consumption rates (Sommer et al. 2001).

As juvenile Chinook salmon grow, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tide into shallow water habitats to feed (Allen and Hassler 1986). In Suisun Marsh, Chinook salmon YOY outmigrants tend to remain close to the banks and vegetation, near protective cover, and in dead-end tidal channels (Moyle et al. 1986). Juvenile Chinook salmon exhibit a “diel” migration pattern, whereby they orient themselves to nearshore cover and structure during the day, but moving into more open waters at night (Kjelson et al. 1982). The fish also distributed themselves vertically in relation to ambient light. During the night, juveniles were distributed randomly in the water column, but would school up during the day.

Juvenile winter-run Chinook salmon migrate to sea after four to seven months of river life (ocean-type life history) (Myers et al. 1998, Healey 1991, Groot and Margolis 1991). Winter-run Chinook salmon mature at sea between two and four years of age (NMFS 1997a).

The Sacramento River winter-run Chinook salmon is listed as endangered. The ESU consists of only one population that is confined to the upper Sacramento River in California’s Central Valley.

NMFS designated critical habitat for winter-run Chinook salmon as the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta, including Kimball Island, Winter Island, and Brown’s Island; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge. Critical habitat for winter-run Chinook salmon does not include Old River or Connection Slough in the central Delta.

Central Valley spring-Run Chinook Salmon

Central Valley spring-run Chinook salmon ESU consists primarily of three populations in three tributary systems (Mill, Deer, and Butte creeks) and also the Feather River and Clear Creek, all within the Sacramento River Basin. The population utilizes rearing and migration habitats in the Sacramento River Basin Delta and San Francisco Bay and offshore ocean waters.

Spring-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months (stream-type life history). (Myers et al. 1998, Healey 1991, Groot and Margolis 1991). Adult spawning migration through the Delta occurs from February through July (ENTRIX 2008). Spawning occurs in Sacramento River tributaries from late-September through mid-November. Fry emerge from the gravel from November to March and spend about 3 to 15 months in freshwater habitats prior to emigrating to the ocean (Kjelson et al. 1981). Spring-run Chinook salmon generally mature between two and four years of age.

In addition to rearing in natal streams, spring-run Chinook salmon juveniles rear in the lower part of non-natal tributaries and intermittent streams during the winter months (Maslin et al. 1997, Snider 2001). Emigration can be highly variable (DFG 1998). Some juveniles may begin outmigrating soon after emergence, whereas others over-summer and emigrate as yearlings with the onset of intense fall storms (DFG 1998). The emigration period for spring-run Chinook salmon extends from November to early May (DFG 1998). Emigration appears to coincide with high precipitation and high Sacramento River flows.

Central Valley spring-run Chinook salmon is listed as threatened. The ESU consists of spring-run Chinook salmon occurring in the Sacramento River Basin as previously listed (June 28, 2005, 70 FR 37160).

NMFS designated critical habitat for Central Valley spring-run Chinook salmon as the Sacramento River and specific tributaries occupied by spawning and rearing spring-run Chinook, as well as the Sacramento Delta Hydrologic Unit within the Sacramento-San Joaquin Delta. Critical habitat does not include Old River or Connection Slough in the central Delta.

Central Valley Fall/ Late Fall-Run Chinook Salmon

Central Valley fall/late fall-run Chinook salmon occur in the Sacramento River and its tributaries, Suisun Marsh, the San Joaquin River and five of its east-side tributaries including the Merced, Tuolumne, Stanislaus, Mokelumne, and Cosumnes rivers. Late fall-run Chinook salmon occur only in the Sacramento River and its tributaries (Moyle 2002). The Central Valley ESU is considered the southernmost native spawning population of Chinook salmon.

Fall-run Chinook are currently the most numerous of the Central Valley runs (Myers et al. 1998) and the only race that regularly spawns in the San Joaquin Basin. Late fall-run Chinook only occur in the Sacramento River where the population appears to be stable, despite its low abundance (NMFS 2008).

Fall-run are ocean-type Chinook that tend to enter freshwater as fully mature fish, migrate to lowland reaches of large rivers and tributaries, and spawn within a few days or weeks of arriving on the spawning grounds (Healey 1991, Moyle 2002). Late fall-run are mostly stream-type Chinook that enter freshwater as large older adults, migrate to mainstem reaches of tributaries, and then hold for one to three months before spawning (Moyle 2002). Adult immigration through the Delta generally occurs from August through November for fall-run and September through November for late fall-run. Fall-run Chinook spawn between late October to early December in

tributaries of the Sacramento Basin and San Joaquin Basin. Late fall-run Chinook spawn from early January to April in Sacramento Basin tributaries (Moyle 2002).

Fall-run juveniles emerge from the gravel in spring and disperse downstream within a few months to rear in main river channels or the estuary before heading out to sea. Fall-run fry and juveniles use the Delta for rearing habitat between January and June, although it is not known what fraction of juvenile production rears in the Delta. Late fall-run juveniles rear for 7 to 13 months in main river channels, feeding on invertebrates and growing rapidly, before migrating to the ocean (Moyle 2002) during November through March.

The majority of fall-run juveniles emigrate through the Delta from February through June during the first few months following emergence, although some may remain in freshwater and migrate as yearlings. Following their long freshwater residence time, late fall-run juveniles emigrate from the Sacramento River through the Delta during November through March.

The fall/late fall-run of Central Valley Chinook salmon are classified as a Species of Concern (69 FR 19975). Because this species is not listed as threatened or endangered, no critical habitat has been determined.

Central Valley Steelhead

Steelhead is the anadromous form of rainbow trout (*Oncorhynchus mykiss*). Unlike other species of salmon, steelhead do not necessarily die after spawning. Populations in the Central Valley are found principally in the Sacramento River and its tributaries, as well as the Mokelumne River. Steelhead have also been documented in the Cosumnes, Calaveras and Stanislaus Rivers (Cramer 2000) on the San Joaquin System.

Adult steelhead enter the upstream rivers from July through May, with peaks in September and February. Adult migration through the Delta generally occurs from September through May, with the peak in December through February. Steelhead historically used upper stream reaches and small tributaries, but now are confined to lower stream reaches below dams.

Adults spawn in the tributaries from December through April (McEwan and Jackson 1996, Busby et al. 1996). After spawning the surviving adults move downstream through the Delta and back toward the ocean from January through May. Yearling steelhead feed on various aquatic insects adjusting their seasonal diets to other aquatic and terrestrial insects or salmonid eggs. Juvenile steelhead generally emigrate from natal streams during fall through spring. They use tidal and non-tidal marshes and shallow Delta areas prior to seaward emigration.

Central Valley steelhead migrate to the ocean after spending one to three years in freshwater (McEwan and Jackson 1996). Once in the ocean, they remain for one to four years growing before returning to their natal streams to spawn. Rearing and ocean-emigrating steelhead use the lower reaches of the Sacramento River and the Delta including tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas.

The Delta may provide rearing habitat for juvenile steelhead (McEwan and Jackson 1996). Juvenile steelhead rear and forage in the south Delta or use the area for transit during seaward migration. Shoreline areas and associated vegetation are important habitat for foraging and cover from predators. Simplified channel habitats, especially those managed primarily for water conveyance and recreation, do not provide the most suitable habitats for maximum productivity.

The Central Valley steelhead Distinct Population Segment (DPS) is listed as federally threatened. Critical habitat for the Central Valley steelhead DPS includes 2,308 miles of stream habitat in the Central Valley including the Sacramento River and tributaries, San Joaquin River east side tributaries up to the Merced River, and an additional 254 square miles of estuary habitat in the San Francisco-San Pablo-Suisun Bay complex. Most all of the main south/central Delta waterways adjacent to the Project area are designated critical habitat.

4.4.1.10 Other Special Status Species

Sacramento Splittail

This endemic fish is a large minnow with a tolerance for saline waters (Moyle 2002). Once found throughout low elevation lakes and rivers of the Central Valley from Redding to Fresno, this native species now occurs in the lower reaches of the Sacramento and San Joaquin rivers and tributaries, the Delta, Suisun and Napa marshes, Sutter and Yolo bypasses, and tributaries of north San Pablo Bay. Although the Sacramento splittail is generally considered a freshwater species, the adults and subadults have an unusually high tolerance for saline waters.

The splittail generally spawns over beds of submerged vegetation in slow-moving waters. This can occur in dead-end sloughs or on flooded terrestrial lands. Spawning occurs from February through May. Hatched larvae remain is shallow, weedy areas until later in the summer when they move to deeper pelagic waters. Young splittail may occur in shallow and open waters in the Delta but are historically more abundant in the northern and western Delta (SWRCB 1999).

Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*) and opportunistically on earthworms, clams, insect larvae, and other invertebrates. They are preyed upon by striped bass and other predatory fish in the estuary.

The Sacramento splittail is a federal species of concern and a California species of special concern.

River Lamprey

The river lamprey is a federal species of concern and a California species of special concern. Its natural range is from southern Alaska to San Francisco Bay, including the Delta and adjacent rivers (Moyle et al. 1995). Adults migrate back into fresh water in the fall and spawn during the winter or spring months in small tributary streams. Specific habitat requirements of spawning adults are clean, gravelly riffles in permanent streams for spawning. The ammocoetes require sandy backwaters or stream edges in which to bury themselves, where water quality is continuously high and temperatures do not exceed 25°C.

River lampreys prey on a variety of fishes, but the most common prey seem to be herring and salmon. Unlike other species of lamprey in California, river lampreys typically attach to the back of the host fish, above the lateral line, where they feed on muscle tissue. Feeding continues even after the death of the prey. The effect of river lamprey predation on prey populations is minimal. River lampreys can apparently feed in either salt or fresh water.

4.4.2 Regulatory Setting

4.4.2.1 Federal

Federal Endangered Species Act

The ESA of 1973 protects plants and animals that are listed by the federal government as "endangered" or "threatened." The ESA is enforced by the USFWS and NMFS. NMFS' jurisdiction is limited to the protection of marine mammals and fishes and anadromous fishes; all other species are within the USFWS' jurisdiction. Section 9 makes it unlawful for anyone to "take" (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in such conduct) a listed animal, including significantly modifying its habitat. Section 7 of the ESA requires federal agencies to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of habitat critical to such species' survival.

Each federal agency must consult with the USFWS or NMFS, or both, regarding federal agency actions. The consultation is initiated when the federal agency determines that its action may affect a listed species and submits a written request for initiation to the USFWS or NMFS, along with the agency's biological assessment of its proposed action. If the USFWS or NMFS concurs with the action agency that the action is not likely to adversely affect a listed species, the action may be carried forward without further review under the ESA. Otherwise, the USFWS or NMFS, or both, must prepare a written biological opinion describing how the agency action will affect the listed species and its critical habitat. This Project will require a permit from the Corps under Section 404 of the Clean Water Act. This agency will provide the nexus for the Section 7 ESA consultation.

Clean Water Act

Section 404 of the Clean Water Act FIX ACRONYMS LATER. establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Activities regulated under this program include fills for development, water resource projects (e.g., dams and levees), infrastructure development (e.g., highways and airports), and conversion of wetlands to uplands for farming and forestry. Section 404 of the CWA authorizes the Corps to issue permits regulating the discharge of dredged or fill material into the waters of the United States, including wetlands. There are two basic types of Section 404 permits issued by the Corps, individual and general. An individual permit is usually required for potentially significant impacts, while a general permit (sometimes called a nationwide permit) can be granted for discharges with only minimal adverse effects. If threatened or endangered species may be affected by the proposed activity, the Corps will also consult with the appropriate federal agency (e.g., USFWS) regarding effects to the species, as regulated under Section 7 of the ESA.

The state also has a role in the Section 404 process. California regulates discharges of fill and dredged material under Section 401 of the CWA and the Porter-Cologne Water Quality Control Act. The appropriate Regional Water Quality Control Board, in this case the Central Valley RWQCB, must issue a Water Quality Certification for discharges requiring Corps permits for fill and dredge discharges remains a core responsibility.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 USC 661 et seq.) requires federal agencies to consult with USFWS, or, in some instances, with NMFS and with state fish and wildlife resource agencies before undertaking or approving water projects that control or modify surface water. The

purpose of this consultation is to ensure that wildlife concerns receive equal consideration water resource development projects and are coordinated with the features of these projects. The consultation is intended to promote the conservation of fish and wildlife resources by preventing their loss or damage and to provide for the development and improvement of fish and wildlife resources in connection with water projects. Federal agencies undertaking water projects are required to fully consider recommendations made by USFWS, NMFS, and state fish and wildlife resource agencies in project reports and to include measures to reduce impacts on fish and wildlife in project plans.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act established a management system for national marine and estuarine fishery resources. Pursuant to section 305(b)(2), all federal agencies are required to consult with NMFS regarding any action permitted, funded, or undertaken that may adversely affect "essential fish habitat (EFH)." Effects on habitat managed under any relevant Fishery Management Plans must also be considered. For this project, the EFH assessment is integrated into this MND/EA.

As discussed earlier, EFH is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." This includes migratory routes to and from anadromous fish spawning grounds. The phrase "adversely affect" refers to the creation of any impact that reduces the quality or quantity of essential fish habitat. Federal activities that occur outside of an EFH but that may, nonetheless, have an impact on EFH waters and substrate must also be considered.

Chinook salmon are covered under the Pacific Salmon Fishery Management Plan and therefore have EFH designated. The Project area does include EFH for migrating and rearing fall-run and intermittently for holding or rearing late fall-run Chinook salmon. The Project area does not include EFH for winter-run or spring-run Chinook salmon, which pass to the north for spawning in the Sacramento Basin. Another species, the starry flounder (*Platichthys stellatus*), is covered under the Groundfish Management Plan.

4.4.2.2 State

California Endangered Species Act

CESA (Fish and Game Code Sections 2050 to 2097) is similar to the ESA. California's Fish and Game Commission is responsible for maintaining lists of threatened and endangered species under the CESA. CESA prohibits the take of listed and candidate (petitioned to be listed) species. DFG may authorize incidental take of listed species pursuant to a DFG-approved NCCP.

4.4.2.3 Local

Contra Costa County General Plan

Contra Costa County considers Connection Slough and Old River to be "Significant Ecological Resource Areas" (SERAs). SERAs are defined by one or more of the following characteristics: (1) areas containing rare, threatened and endangered species; (2) unique natural areas; and (3) wetlands and marshes.

The relevant policies of the Conservation Element are listed below:

> 8-3. Watersheds, natural waterways, and areas important for the maintenance of natural vegetation and wildlife populations shall be preserved and enhanced.
>
> 8-9. Areas determined to contain significant ecological resources, particularly those containing endangered species, shall be maintained in their natural state and carefully regulated to the maximum legal extent. Acquisition of the most ecologically sensitive properties within the County by appropriate public agencies shall be encouraged.
>
> 8-10. Any development located or proposed within significant ecological resource areas shall ensure that the resource is protected.
>
> 8-16. Native and/or sport fisheries shall be preserved and re-established in the streams within the County wherever possible.
>
> 8-79. Creeks and streams determined to be important and irreplaceable natural resources shall be retained in their natural state whenever possible to maintain water quality, wildlife diversity, aesthetic values, and recreation opportunities.
>
> 8-81. Fisheries in the streams within the County shall be preserved and re-established wherever possible.

San Joaquin County General Plan

San Joaquin County identifies both the Old River and Connection Slough sites as "Significant Natural Resource Areas" (Old River is Waterway and Riparian; Connection Slough is Waterway only).

The Resources Element contains the following policies that are relevant to the Project:

> 1. Resources of significant biological and ecological importance in San Joaquin County shall be protected. These include wetlands; riparian areas; rare, threatened and endangered species and their habitats as well as potentially rare or commercially important species; vernal pools; significant oak groves and heritage trees.
>
> 11. Fisheries shall be protected by:
>
> (b) designing and timing waterway projects to protect fish populations; and
>
> (c) operating water projects to provide adequate flows for spawning of anadromous fish.

4.4.3 Impacts and Mitigation Measures

4.4.3.1 No Project Alternative

Under the No Project alternative, none of the potentially adverse impacts would occur, nor would any of the benefits to delta smelt and other sensitive aquatic species.

4.4.3.2 2-Gates Project

a. Have a substantial adverse impact, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service

Construction is planned to occur in the late summer through fall when delta smelt, longfin smelt and winter- and spring-run Chinook salmon would not be present. Green sturgeon and juvenile steelhead have the potential to occur, but in low densities, at the construction sites during the construction period.

Operations impacts generally would be beneficial because the Project would reduce entrainment of aquatic species by the Delta export pumps. The periodic closures of the Project facilities would temporarily cause changes in water quality, migration routes, site-specific predation and the development of conditions conducive to spawning and rearing of delta smelt in some portions of the central and south Delta. Each of these impacts is discussed below on a species-by-species basis.

Delta Smelt

CONSTRUCTION

Less than Significant. Construction of the Project facilities would occur when adult delta smelt would not be present in Old River and Connection Slough. Barge-gate installation would be timed to occur when delta smelt are generally located in the west Delta.

Performance criteria would be used to comply with permit conditions as outlined in Section 2. Any additional turbidity caused by Project construction would be attenuated by slowing or suspending dredging operations to bring water quality criteria into compliance in the local area of construction and therefore would not result in the exposure of delta smelt in the west Delta to excessive turbidity during dredging operations and other in-water activities, such as sheet pile installation and barge placement.

Barges would be cleaned before they were submerged, and residual oils, lubricants, or other contaminants would be removed prior to their placement in the channels. Therefore, delta smelt would not be exposed to contaminants from this source. There is a potential for accidental spills to occur during construction, but all spills would be cleaned up in accordance with the spill prevention measures detailed in the Storm Water Pollution Prevention Plan (SWPPP) that would be required. Any effects would be temporary and limited to a small geographic area and would not substantially affect delta smelt populations.

Delta smelt feed primarily on pelagic copepods and other zooplankton, so the alteration or loss of benthic invertebrate habitat in the area being dredged or covered with rock fill would not affect food availability for this species.

OPERATIONS

Beneficial. During December through June under existing hydrodynamic conditions, all life stages of delta smelt would at some time be present at or near the gate locations. Adults would predominate in December through February, and other life stages would increase in abundance from February through June. Operation of the gates would restrict the development of water quality characteristic that are correlated with pre-spawning delta smelt movement into the central and south Delta and prevent adult delta smelt from entering the Old River channels south of

Franks Tract prior to spawning. The Project would substantially reduce the loss of individual delta smelt from entrainment because the Project would reduce and minimize the establishment of water quality conditions attractive to adult delta smelt in the south Delta. When the gate are closed, delta smelt would generally be unable to enter the south Delta by the most direct route, so they would spawn near Franks Tract, in the San Joaquin River, or in other areas more distant from the conveyance channels or the pumps. Because the gates would be operated to reduce entrainment of sensitive aquatic species (see Appendix E for further details), juvenile and larval delta smelt present in the area around Franks Tract would have a much lower probability of being entrained by the export the pumps and a higher probability to be transported westward into Suisun Bay. This action would reduce entrainment losses during the December through June period and contribute to the maintenance and recovery of the species. Results from the delta smelt adult behavioral and larval model simulations indicate a substantial benefit to adult, larval and juvenile delta smelt that would be present in the area in and around Franks Tract due to reduced entrainment into the conveyance channels leading to the pumps (see Appendix E).

Less than Significant. The Project's effects related to water quality, predation, spawning areas, rearing habitat, and adult migration patterns, are discussed below.

WATER QUALITY

As described in more detail in Section 4.9, the Project would result in two different types of changes to water quality. Minor changes in water quality immediately adjacent of the Project facilities would occur during operations of the gates. When closed, the gates would create temporary dead-end sloughs. Portions of channels adjacent to the Old River and Connection Slough barriers would receive reduced mixing, which could result in slightly degraded water quality in the form of somewhat reduced oxygen and minor changes in salinity, and may temporarily trap floating debris. This condition would persist approximately for the duration of the gate closure. These changes would be a less-than-significant impact to delta smelt. Project operations would also result in changes to water quality parameters adjacent to the "region of influence" in the central Delta, described in Section 2, and in waters in the south Delta. This would reduce the establishment of turbidity and salinity considered to be components of pre-spawning delta smelt habitat in areas where they would be subject to entrainment from the SWP and CVP export pumps. This would be a beneficial impact to delta smelt because entrainment would be reduced.

PREDATION

Predation impacts would be less than significant because gates would be operated frequently, thereby limiting the duration of this accumulation of prey; and only a very limited area would be temporarily affected.

SPAWNING

While the south Delta has been used for spawning prior to the 1980s, it is believed that the area is not currently an important source for production of delta smelt (CBD 2006); therefore, any impacts to spawning habitat and the access to potential spawning habitat would be less than significant. Impacts to overall spawning success would be beneficial since entrainment of pre-spawning delta smelt would be reduced. Moreover, under current conditions, most progeny produced in the central Delta have a high probability of being entrained at the pumps. Partial isolation of the central Delta spawning area from the south Delta

and the partial isolation of other suitable habitat from the pumps would increase survival of the larval delta smelt and would benefit the species.

REARING HABITAT

Rearing habitat has been correlated with that of the location of the 2 ppt isohaline (X2). The CVP and SWP are required to maintain X2 at various points depending on water year type by SWRCB Water Right Decision 1641 (D-1641). These requirements would remain in place when the Project facilities are in operation. Thus, the Project operations would not affect rearing habitat.

ADULT MIGRATION

Adequate flow and suitable water quality is needed to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their tributaries (USFWS 1994). Adult delta smelt begin migrating up the Sacramento and San Joaquin rivers and their tributaries in December triggered by the increase in turbidity and decrease in salinity associated with the onset of winter storms. Because of its location and hydrodynamic connections, the Project would not change flows in the Sacramento River or its upstream tributaries. When the gates are closed, the Project would temporarily alter the regional flow-path of water in some portions of the Delta region. Operation of the gates would tend to reduce the establishment of conditions conducive to adult delta smelt migration south and east of the "region of influence." Tidal operations of the gates would tend to restrict or preclude adult delta smelt south of Franks Tract via the Old River. The greatest change to flow rates would be found in the channels immediately adjacent to the Project facilities. On a more regional basis, water that would currently flow in the Old River or Connection Slough channels would be re-directed to other nearby north-south channels (e.g., Middle River). Delta smelt migration routes would be reduced in the Old River and Connection Slough channels and be re-routed to other adjacent Delta channels or to other portions of the Delta (generally north and west of the Project facilities and "region of influence") that had water quality characteristics that are attractive to adult delta smelt migration. When the gates are open, the Project would have an undetectable effect on Delta hydrology and water quality. If the Project gates and adjacent sheetpile dikes are removed at the end of the demonstration phase, the Project would have no effect on hydrology and water quality in the Delta. These changes were compared using historic flow and salinity data for the period 1991 to 2006. Detailed results are available in Appendix E.

North American Green Sturgeon

Green sturgeon may be infrequently present in the Old River and Connection Slough at any time of year. Adult and juvenile sturgeon forage throughout the Delta.

CONSTRUCTION

Less than Significant. Green sturgeon are found throughout the Delta during the construction period and are likely to occur at the Project locations. Underwater noise generated by dredging, rock placement, or pile driving would be transient, occurring during the daytime over a five-week period. The hearing sensitivity of green sturgeon is unknown. Noise from pile driving would be reduced by using vibratory hammers, which are generally much quieter than impact hammers (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2009). Rock placement would also

generate underwater noise from equipment striking rock. The effects of pile driving have been assessed by NMFS and others (NMFS 2008d, Popper et al. 2006). Specific transient underwater noise associated with dredging, rock placement, surface machinery and topside activities on the barge decks would reach the same levels as from pile driving. Construction activities would not exceed NMFS's 2008 interim thresholds for sound pressure levels of 206 dB peak and 187 dB accumulated sound. The effects of noise would be transient and localized, and would be less than significant.

As discussed in Section 2, performance criteria would be used to comply with permit conditions, ensuring that impacts associated with turbidity and resuspension of channel sediments would be less than significant. Construction activities would not directly affect spawning, which occurs well upstream in the Sacramento River watershed from March through July, or offspring development occurring in the following months.

OPERATIONS

Less than Significant/Beneficial. The Project would result in changes to water quality, potential predation, access to spawning areas, rearing habitat, and adult migration patterns, as discussed below.

WATER QUALITY

Water quality impacts would be as described for delta smelt.

PREDATION

Proposed operations would prevent largemouth bass or striped bass from consistently utilizing the area. Thus, operations would lessen the overall effects of the structure to support predator habitat.

SPAWNING

Green sturgeon spawning occurs well upstream of the Delta so the Project structures and operations would have no effect on spawning activities. Adult green sturgeon in the Franks Tract area migrating to spawn in the Sacramento River would not be prevented from moving upstream into the Sacramento River. Movement of adult fish from the south Delta to the Sacramento River would be impaired, but not prevented. Project operations would not restrict movement elsewhere in the system to access upstream spawning habitat. Rather, the gates would impede movement directly into and out of the Old River from the Franks Tract area and collectively provide one of the two main routes up the San Joaquin River where spawning is not known to occur.

REARING HABITAT

Juveniles rear in fresh and estuarine waters for about one to four years before dispersing into the ocean (Nakamoto et al. 1995, NMFS 2008a). The Project would not substantially modify water quality or remove a substantial amount of soft-bottom habitat from the Delta and therefore would not significantly affect sturgeon rearing.

ADULT MIGRATION

Operation of the gates would tend to reduce entrainment into the south Delta from the Franks Tract area, which would be a beneficial impact.

Adults and subadults primarily inhabit the Delta and bays during summer months, most likely for feeding and growth (Kelly et al. 2007, Moser and Lindley 2007), but also enter the Delta and bays during their spring migration to the Sacramento River and during their winter outmigration from the Sacramento River to the ocean (NMFS 2008a). Project operations have the potential to impede sturgeon movement as they forage throughout the Delta and may affect their movement even during periods when the gates are open. Green sturgeon are bottom dwellers, mostly staying in contact with bottom sediments to forage. Gate structures could impede movement of bottom-dwelling fish that encounter the vertical side of the barges; however, to encourage fish to continue their movements, a sloping rock ramp would be installed on either side of both gates. The ramps would facilitate fish movement from the bed of the channel up to the deck of the barge where they can continue their movement up or down the channel when the gates are open. Moreover, neither barge-gate would prevent access to other areas of the Delta, and green sturgeon could move around the gates by swimming a longer distance through other channels to reach other locations. Additionally, when the gates were open as they would be much of the time, sturgeon would be able to pass through the gate structures.

Chinook Salmon

CONSTRUCTION

Less than Significant. Adult spring- and winter-run and juvenile spring-, winter-, and fall-run Chinook salmon would not be present in the vicinity of the Project or in the Delta at any time during the construction period. Early migrating, adult fall-run Chinook salmon could be present in the construction period. Fall-run Chinook salmon are produced from both the Sacramento and San Joaquin river systems. Juvenile Chinook salmon from all runs could be present at the Project sites during the construction period; however, the tendency is that a substantially lower proportion of the Sacramento River-produced juveniles would be exposed to the Project construction activities compared to the proportion of the San Joaquin River late fall-run juvenile fish.

Construction impacts generally would be similar to those described for delta smelt; any salmon in the vicinity of construction activities would have the ability to move away. Any modification of the benthic community would have no significant adverse effect on juvenile winter- or spring-run Chinook because the affected area would be very small.

Existing riparian function is already degraded and very small in relation to the size of the channel in Old River or Connection Slough. Construction of the abutments would have no significant effect on juvenile salmonids in the Delta.

OPERATIONS

Less than Significant/Beneficial. Juvenile winter-, spring-, and fall-run Chinook salmon are likely to be present in the Delta during operations. Late fall-run juveniles are not anticipated to be in the Delta after March. Adult winter and spring-run Chinook migrate through the Delta during this time frame. The two salmon runs primarily use the Sacramento River side of the Delta.

WATER QUALITY

Water quality impacts near the Project facilities would be as described for delta smelt. Project operations in the late spring and early summer could slightly

modify water quality that serves as a cue to out-migrating Chinook salmon, especially those emanating from the San Joaquin River tributaries and steams discharging directly into the Delta (e.g., Mokelumne River). Since Project operations would cease during the VAMP period (generally April 15 to May 15), the Project would not adversely impact water quality that serves as a cue to Chinook salmon outmigration during this period. Given the implementation of monitoring and adaptive management of the Project facilities before and after the VAMP period, impacts to out-migrating Chinook salmon would be less than significant.

PREDATION

Predation impacts near the Project facilities would be as described for delta smelt. Predation rates elsewhere in the Delta would be unaffected by the Project.

SPAWNING

Chinook salmon spawning occurs outside of the Delta; therefore, the Project would not affect Chinook salmon spawning.

REARING HABITAT

The principal rearing habitat for juvenile Chinook salmon in the Delta is shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels and sloughs (McDonald 1960, Dunford 1975). The Project site does not provide of this type of habitat since the sites are deeper open channels with steep-sided levees at each bank. Therefore, the Project would have a less-than-significant effect on the availability of rearing Chinook salmon habitat.

Juvenile Chinook salmon move through the Delta to reach high quality rearing habitat (and eventually the ocean). The timing of this movement varies for each run. Juvenile Chinook salmon from the San Joaquin River watershed and the Mokelumne River and juvenile Chinook from the Sacramento River watershed using portions of the central Delta while moving toward higher quality rearing habitat would encounter both positive and negative changes in hydrology from the changes in entrainment flows from the SWP and CVP pumps. Under certain hydrologic conditions, the gates would be effective at reducing the entrainment of juvenile Chinook salmon and other pelagic fish from the western and central portions of the delta to the pumps while under other hydrologic conditions operations of the gates provides little benefit. Operations of the gates would be scheduled to minimize adverse effects on the movement of juvenile Chinook salmon. (See Section 4.9 and Appendix E for more information about local and regional hydrologic effects.) The peak of this downstream movement of juvenile Chinook salmon near the Project site occurs during the VAMP period. The gates would be open during this period to minimize the effects on juvenile Chinook salmon movement toward higher quality rearing habitat. Project operations from March through June are timed with tidal cycles. This would not impede juvenile Chinook salmon that follow the same cycle in their movements within the Delta and other estuarine habitats. Given the implementation of monitoring and adaptive management of the Project facilities before and after the VAMP period, impacts to out-migrating Chinook salmon would be less than significant.

ADULT MIGRATION

Adult Chinook salmon move through the Delta to reach spawning habitat in the Sacramento and San Joaquin River watersheds. The timing of this movement varies for each run. Because of the strength of their swimming characteristics and the timing of the upward migration the Project would have little to no adverse effect on Sacramento River spring and winter run Chinook salmon. Likewise, because of the location of the Project and its ability to reduce localized entrainment from the SWP and CVP pumps, the Project would have less-than-significant effects on fall and late-fall Chinook salmon runs from the Sacramento River.

When closed, the gates would act as temporary barriers to movement through Old River and Connection Slough, thus limiting the movement of fall-run Chinook salmon adults upstream to their spawning grounds in the San Joaquin River tributaries and streams directly discharging into the Delta (e.g., Mokelumne River).

Steelhead

Steelhead are encountered in the Delta during most of the year, but they are present primarily from November through June, with a peak in February to March. Juvenile outmigration peaks from March through May, which has some overlap with their peak appearance in salvage at the pumps. Juveniles from the Sacramento River system, Mokelumne and Stanislaus rivers migrate downstream through the Delta from November through June. Adult steelhead migrate through the Delta from September through May. The effects of operations on juvenile and adult steelhead are variable depending on the river system of origin. Effects of gate operations on San Joaquin and Mokelumne River fish are also discussed below.

CONSTRUCTION IMPACTS

Less than Significant. The effects on steelhead would be similar to the effects on early fall and fall-run Chinook salmon.

OPERATIONS IMPACTS

Less than Significant/Beneficial. Juvenile steelhead would be expected to be within or passing through the Project area during operations.

WATER QUALITY

Water quality impacts would be as described for Chinook salmon.

PREDATION

Predation impacts would be as described for Chinook salmon.

SPAWNING

Steelhead spawning occurs outside of the Delta. The Project would not affect steelhead spawning.

REARING HABITAT

Steelhead rearing habitat and movement are similar to those described for Chinook salmon. Impacts to steelhead rearing would be as described for Chinook salmon.

ADULT MIGRATION

Adult steelhead migration generally occurs from August through March. Most adults headed for the Sacramento and Mokelumne River tributaries would not be affected by the operation of the Project facilities. Adults headed up the San Joaquin River tributaries would use the main San Joaquin River channel for their upstream migration, and some adults would use the other major pathway up Old River before reconnecting with the San Joaquin River at the head of Old River. Other deviations occur and can result in adult fish moving throughout the interior channels of the south-central Delta. Tidal and episodic gate openings would facilitate the upstream migration of adult steelhead that have been delayed in the area.

Post-spawning steelhead from the Feather, American, and other Sacramento rivers would not be substantially affected by Project operations since a majority of the fish would move down the Sacramento River channel. Some fish move down Georgiana Slough or through the Delta Cross Channel when it is open and into the Lower Mokelumne River system. Project-related changes in hydrology would not substantially affect adult steelhead outmigration. When closed, the gates would act as barriers to movement through these channels and thus prevent direct movement of San Joaquin River and Mokelumne River steelhead adults through Connection Slough to the east Delta or to the San Joaquin River or through Old River to the San Joaquin River. Adults could still move up the San Joaquin River or through Middle River. The gates would pose an obstacle to migrating adults moving through the Central Delta. However, most adults would use the main river channel for their upstream migration and, in doing so, avoid the gates. Implementation of mitigation monitoring and adaptive management of the Project facilities before and after the VAMP period would assure that impacts to outmigrating steelhead would be less than significant.

Longfin Smelt

CONSTRUCTION

Less than Significant. Adult and juvenile longfin smelt would typically not be present in the Old River and Connection Slough during the construction period. Impacts generally would be as described for delta smelt, although relatively few longfin smelt appear to utilize Old and Middle rivers based on DFG trawl data, so impacts would be lessened.

OPERATIONS

Less than Significant/Beneficial. Juvenile and adult longfin smelt could be present during operations.

WATER QUALITY

Water quality impacts would be as described for delta smelt.

PREDATION

Predation impacts would be as described for delta smelt.

SPAWNING

Since longfin smelt tend to aggregate in Suisun Bay and the western Delta in late fall, and then spawn in freshwater areas immediately upstream between the confluence of the Sacramento and San Joaquin Rivers up to Rio Vista on the Sacramento River and Medford Island on the San Joaquin River during winter and early spring, the reduced entrainment from the Project would reduce impacts to longfin spawning.

REARING HABITAT

Longfin smelt larvae are generally located slightly upstream of the Sacramento-San Joaquin River confluence in the Delta near Sherman Island (Baxter 1999, Dege and Brown 2004). Juveniles migrate further downstream to Suisun Bay and low-salinity habitats for growth and rearing (Moyle 2002). During gate operations, adult longfin smelt, eggs, and larvae would be in the Project area and would be subject to reduced entrainment by the SWP and CVP pumps. When the gates are closed, the structures would prevent juvenile longfin smelt from being entrained from the Franks Tract area into the conveyance channels of Old and Middle Rivers and being carried directly to the CVP and SWP pumps. As with delta smelt, this Project would benefit longfin smelt by substantially reducing the entrainment effect on habitats north and west of the gates and thereby reducing the number of larval and juvenile fish being drawn south towards the pumps and entrained.

ADULT MIGRATION

Adult longfin smelt are at risk from entrainment at the SWP and CVP pumps for in the late fall and winter. Project operations would prevent direct movement of fish past these gates into Old and Middle Rivers from the Franks Tract area. If adult longfin smelt were to encounter the closed gates during their migration, then these smelt would have to move about the Delta following other routes, but these direct connections between Franks Tract and the pumps would be severed, which would be a beneficial impact.

b. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service

This issue is addressed in Section 4.5, Terrestrial Biological Resources.

c. Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means

This issue is addressed in Section 4.5, Terrestrial Biological Resources.

d. Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites

Construction Impacts

Less than Significant. Most aquatic species would flee the area to avoid the construction activity and human activity.

Dredging could entrain and injure resident and migratory fish if they are in the construction area during periods of construction. This is not expected, however, because the density of fish would be low and fish would avoid the area due to human activity (e.g., noise and lights). Aquatic species could be exposed to the indirect effects of dredging, including the potential release of additional sediment. However, the suspension of sediments would be controlled to avoid this impact as detailed in Section 2 and would not impede movement.

Barge placement could entrain a small amount of aquatic species in the water used to ballast the barge. Direct harm or mortality due to crushing between the barge and the foundation material would not occur due to the slow rate of submersion and the ability of fish to avoid the local area.

Dredged areas backfilled with rock would alter bottom habitat from soft sediment to hard substrate. Exposed rock foundation would increase local hard habitat structure in the channels and cover soft mud or peat substrate habitat. The soft bottom habitat is important to the development of larval and juvenile life forms, but it is a common in-channel habitat type in the Delta, and the small reduction in the habitat would not be a limiting factor to the reproduction and rearing of aquatic species.

Operational Impacts

Less than Significant. The Old River and Connection Slough are two of many channels available for the migration of movement routes available to aquatic species. Movement of migratory fish and other aquatic species does occur in other channels in the Delta (e.g., the Middle River). At some times of each year, the Project would slightly alter the flow rate, flow direction, and water quality of portions of the Delta, resulting in temporary, localized changes in entrainment of species in the eastern and southern Delta. This would not impede movement of migratory fish because of the brief duration and magnitude of the change (refer to Appendix E). Moreover, alternative routes are available to fish moving through the eastern and southern Delta via the mainstem of the San Joaquin River or the Middle River, and fish would move into other areas of suitable habitat. The Project would not interfere with the movement of aquatic species elsewhere in the Sacramento-San Joaquin River watersheds.

To encourage fish to continue their movements, rock ramps on a 5:1 slope would be installed on either side of both gates. The ramps would facilitate fish movement from the bed of the channel up to the deck of the barge where they can continue their movement up or down the channel.

Water quality impacts would be beneficial, or slight increases in salinity would occur during limited periods, and water quality would equalize once the gates were open. Such changes would not substantially affect aquatic species. Water quality is discussed in more detail in Section 4.9, Hydrology and Water Quality.

Beneficial. Native and important introduced fish that normally occupy some portions of the central and southern Delta would have reduced entrainment by the SWP and CVP pumps when

the gates were closed. Aquatic resources that move between the south and central Delta via Old River or Connection Slough, either naturally or by entrainment, would be prevented from such movement when the gates were closed. Plankton and other weak-swimming aquatic organisms that occupy the central Delta are subject to entrainment at the pumps under current conditions. The Project would substantially reduce this loss because native and important introduced fish would generally be unable to enter the south Delta by the most direct route.

e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance

No Impact. The Project would not conflict with any of the policies or goals described in the Contra Costa County or San Joaquin County General Plans because Project design (e.g., the use of sheet pile rather than rock for the dikes adjacent to the operable gates; implementation of performance criteria for turbidity during construction) and operational features (e.g., tidal operations from March through June) would be implemented that would avoid significant impacts. The Project would not cause changes in the ability to comply with regional or statewide water quality criteria or water management policies (e.g., D-1641). Additionally, the Project is intended to protect sensitive aquatic resources and therefore is consistent with policies that stress the preservation and enhancement of sensitive biological resources.

f. Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan

No Impact. The East Contra Costa County Habitat Conservation Plan boundaries exclude the 2-Gates Project area. The San Joaquin Multi-Species Conservation Plan (SJMSCP) covers all of San Joaquin County, so portions of the Project fall within the SJMSCP area. The proposed Project activities, however, would not be "covered activities" under the SJMSCP, and the Project would not conflict with the goals of the plan.

4.4.3.3 Cumulative Impacts

The 2-Gates Project is a demonstration project and as such is designed with considerable operational flexibility. Because of this flexibility and the planned coordination with SWP and CVP pumping and other planned or future projects within the south Delta, cumulative impacts of the Project in combination with other projects would be less than significant or beneficial through the reduction in entrainment.

Bay Delta Conservation Plan (BDCP)

At this time it is anticipated that the Bay Delta Conservation Plan (BDCP) is in the planning and concept development phase. The planning phase will not become final before the end of 2010 with implementation to follow. Given the complexity of this plan and the need for public review and acceptance, it is unlikely that it will be completed and implemented prior to the five-year horizon established for the proposed Project. However, since the Project and the BDCP have similar objectives (i.e., providing for the conservation of ESA-listed species and their habitats [specifically delta smelt] and improving water supply reliability) it is expected that the two projects would be complementary and that cumulative impacts would be beneficial.

Franks Tract Project

It is anticipated that the combined facilities provided by the Project and the Franks Tract Project would provide greater operational flexibility to better manage hydrodynamic conditions and salinity concentration in the central and south Delta, thereby improving water quality and fish

habitat conditions. In addition, it is anticipated that the cumulative impact of the combined operations of the Project and the Franks Tract Project would reduce the likelihood of entrainment of delta smelt from the Franks Tract area. Therefore, cumulative operational impacts would be beneficial. Since the construction periods would not overlap cumulative construction impacts would not occur.

South Delta Improvements Program (SDIP)

The Project and the SDIP would generally be operated during different times of the year. SDIP would be operated from April through November, and Project would be operated from December through June. Therefore, adverse cumulative effects would not occur. Both projects are anticipated to provide greater operational flexibility to protect ESA-listed fish and provide for water supply reliability, and overall cumulative impacts would be beneficial.

CCWD – Water Quality Improvement Projects

The Project may result in cumulative hydrologic changes in south Delta channel flows and related changes in water quality in conjunction with CCWD's water quality improvement projects. Incremental impacts of the Project combined with CCWD's projects to overall Delta channel flows are anticipated to be minimal due to the operational flexibility of both projects. Cumulative changes in channel flows may affect salinity in the south Delta, although these impacts are considered to be less than significant because the Project would implement monitoring to ensure that adverse impacts do not occur.

Los Vaqueros Reservoir Expansion Project

Both the Los Vaqueros Project and the Project are intended to improve water supply reliability while benefiting the Delta ecosystem. General effects of the reservoir expansion may include a net shift in timing of Delta export pumping to periods of less fishery sensitivity, and from dryer years to wetter years. The Project is intended to reduce the entrainment of delta smelt in south Delta pumps. The projects have complementary objectives, and overall cumulative impacts would be beneficial.

CVPIA Required Program

The CVPIA includes a requirement for Reclamation to develop and implement a program to mitigate fishery im pacts resulting from the operation of Pumping Plant No. 1. The program may include a fish screen at Rock Slough (just south of the Old River site) modified operations, or other measures to mitigate fishery impacts. The Project would be operated in a flexible manner that would allow coordinated operations in conjunction with the CVPIA program requirements. Both projects are intended to result in beneficial impacts to aquatic species, and cumulative impacts are expected to be beneficial.

Freeport Regional Water Project

The Freeport Regional Water Project is a water supply project for customers in central Sacramento County and in Alameda and Contra Costa counties in the EBMUD service area. This project includes a water intake/pumping plant located on the Sacramento River near Freeport, and a 17-mile pipeline to convey water from the river through Sacramento County to the Folsom South Canal. Construction is nearly completed. This project would not affect aquatic resources in the Delta; therefore, no cumulative impacts would occur.