Chapter 3 Environmental Analysis

Section 3 describes the affected environment and environmental consequences of the No Action alternative and the Proposed Action. Impacts are addressed at a level of detail that is commensurate with the magnitude of the potential impact. The following sections describe the resources that are analyzed in detail because there is a potential for impacts to occur, as well as those that are not analyzed in detail because no impacts would occur.

Resources Analyzed in Detail

The resource areas listed below have the potential to be affected by the 2-Gates Project and are discussed in Sections 3.1 through 3.16.

- Aesthetics
- Agricultural Resources
- Air Quality
- Aquatic Biological Resources
- Terrestrial Biological Resources
- Cultural Resources
- Geology
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Noise
- Public Services
- Recreation
- Socioeconomics
- Transportation
- Climate Change

Resources Not Analyzed in Detail

Based on review of the Proposed Action and the affected environment, the following environmental resources were found to not be affected by the Proposed Action and are not analyzed in detail in this EA.

- **Environmental Justice** – The Proposed Action would be located in a remote, rural area, well-removed from the nearest populated areas, and the nearest communities have lower percentages of minorities and persons living below the poverty threshold than the counties as a whole. Farm workers on adjacent properties could potentially be minorities and/or considered low-income populations. However, any impacts of the Proposed Action that would potentially affect farm workers (primarily noise and air emissions) would be temporary and could not exceed any applicable thresholds.
- **Indian Trust Assets** – No Indian Trust Assets are located on or near the Proposed Action.
- **Land Use** - The Proposed Action would primarily be constructed within river channels and would not affect the surrounding agricultural land uses. It would be consistent with the policies included in the Contra Costa and San Joaquin County General Plans, and is intended to protect delta smelt from entrainment by SWP and CVP export facilities while minimizing or avoiding impacts on other aquatic species, and thus is consistent with policies and regulations requiring the protection of such species. The San Joaquin County Multi-Species Habitat Conservation Plan and Open Space Plan (SJMSCP) (2000) covers the entire San Joaquin County. There are portions of the Proposed Action that fall within the SJMSCP area. The Proposed Action would not include "covered activities" under the SJMSCP, and would not conflict with the goals of the plan.
- **Minerals and Energy** - No mineral deposits are present at the proposed sites; therefore, no impacts would occur. The Proposed Action would require energy during construction and operations (e.g., to power the lights in the operator house, flood lights, and operate the gates), and would not conflict with any adopted energy conservation plans.
- **Paleontology** - The results of a paleontological literature search showed no recorded sites within 2 miles of the proposed Old River and Connection Slough sites (University of California Museum of Paleontology 2008), nor were any paleontological resources identified in Quaternary (Holocene-age) deposits that are present at depths of up to 30 feet at these sites. Given the relatively young age of the deposits underlying the Old River and Connection Slough sites (up to 10,000 years before the present [B.P.]), the potential for fossils to be present is low. No excavation would be required at the Roberts Island #1 disposal site, so no impacts would result from its use.
- **Utilities and Service Systems** - The Proposed Action would not generate a need for additional wastewater treatment, nor would it require the construction of storm water drainage facilities. It also would not require water supplies, other than limited amounts needed for dust suppression during facilities construction and removal. Minimal amounts of electric power would be required during construction and gate operations, and would be obtained from the nearby PG&E grid. Pending the PG&E connection, a skid-mounted diesel generator located on an upland area next to the existing levees would be used, which would not affect utilities. The Proposed Action would generate minimal amounts of solid waste during construction and operations. Dredged material would be disposed of on Bacon Island or Roberts Island, and materials removed at the end of five-year demonstration period would be reused to the extent feasible. The nearby landfill has sufficient capacity to accommodate solid waste generated by the Proposed Action.

3.1 Aesthetics

3.1.1 Affected Environment

Visual resources consist of the natural and manmade features that give a particular environment its aesthetic qualities. These features may be naturally occurring or modified by human activities. Together, they form the overall impression of an area, referred to as its landscape character. Landforms, water surfaces, vegetation, and manmade features are treated as characteristic of an area if they are inherent to the formation, structure, and function of the landscape. Landscape character is evaluated to assess whether a proposed project would appear compatible with the existing setting or would contrast noticeably with the setting and appear out of place.

Visual resources also have a social setting, which includes public values, goals, awareness, and concern regarding visual quality. Social setting is addressed as visual sensitivity or the relative degree of public interest in visual resources and concern over adverse changes in the quality of that resource. Visual sensitivity is key in assessing how important an effect on the visual resource would be and whether it represents a significant impact. Recreational uses are generally considered to have high visual sensitivity, as are views from scenic routes or corridors, or along scenic highways and wilderness areas. The primary areas of concern generally are associated with changes to prominent topographic features, changes in the character of an area with high visual sensitivity, removal of vegetation, or blockage of public views of a visually sensitive landscape.

Both the Old River and Connection Slough sites are located in a sparsely populated rural area characterized primarily by agricultural uses, although some wetlands are present in the areas surrounding the river channels. A bridge over Connection Slough is located about 0.3 mile west of the Connection Slough site and a residence and bunkhouse are just north of the bridge. Several marinas are located nearby (one is approximately 0.8 mile south and one is about 1.75 miles southwest of the Old River site). Power lines are present along the adjacent roads, and scattered buildings associated with agricultural uses are located nearby. The surrounding islands contain a combination of fallow land and land that is actively farmed with row crops. Topography is generally flat, although the adjacent islands are considerably lower than the tops of the adjacent levees. Both the Old River and Connection Slough river channels have been modified with rock-lined levees. The immediate vicinity does not contain trees or visually distinctive characteristics.

The Old River site is not accessible to the public by road. The Connection Slough site is located at the terminus of North Bacon Island Road (Figure 2-3), which is designated as a scenic route in the San Joaquin County (1992) General Plan. Located 6 miles to the south of the proposed sites is State Route 4, which is designated as a scenic route by both San Joaquin and Contra Costa counties (San Joaquin County 1992, Contra Costa County 2005); however, these sites would not be visible from this more heavily traveled route. The Open Space Element of the Contra Costa County (2005) General Plan identifies the Old River as a scenic waterway. The Old River and Connection Slough sites are accessible by boaters, but the levees limit views of the surrounding areas from the water.

3.1.2 Regulatory Setting

No federal or state regulations are related to the aesthetic impacts of the Proposed Action. Both the Contra Costa and San Joaquin County General Plans contain policies intended to preserve the aesthetic qualities of the Delta.

3.1.3 Environmental Consequences

3.1.3.1 No Action Alternative

No changes to the aesthetic qualities of the Old River or Connection Slough sites would result from the No Action alternative because no construction would occur.

3.1.3.2 Proposed Action

If more disposal capacity is required than can be accommodated at the Bacon Island disposal site, dredged sediment would be disposed of at Roberts Island. This is an existing disposal site, and no aesthetic impacts would occur from its use for the Proposed Action; thus, use of this site is not addressed further.

Scenic Vistas

A scenic vista is usually considered a rural area containing natural visual elements that can be seen from a distance. A scenic vista can be affected by directly reducing the scenic quality of the vista or by blocking views of the scenic resource. Important factors in determining if a proposed project will block views include its height, mass, and location relative to surrounding land uses and travel corridors. The Old River is identified as a scenic waterway by Contra Costa County, and Connection Slough is near the terminus of the portion of Bacon Island Road that is designated as a scenic route by San Joaquin County; therefore, views of Old River from a distance and views from Bacon Island Road could be considered scenic vistas. The Old River site is not accessible to the public by road, and Bacon Island Road, which is a scenic route, is approximately 2.5 miles east of the Old River site. Therefore, the Proposed Action components at this site would not be visible from Bacon Island Road, and the Proposed Action would not restrict or diminish views of a scenic vista.

The Connection Slough site would be visible from Bacon Island Road; however, this area is quite remote, and there is limited public use because land on either side of Connection Slough is private land in agricultural use; moreover, the gate structure would affect only a small portion of the river channel and the gates would not extend above the levees. The Proposed Action facilities would be visible to boaters, but the facilities would not restrict views of the surrounding areas because the existing levees already block views of the land on the adjacent islands. The facilities would affect views of the river channels in the immediate vicinity, but these immediate views are not considered a scenic vista. Moreover, the river channels already have been modified with riprap-lined levees, and only a small portion of the rivers would be affected. The potential dredged material disposal area on Bacon Island is fallowed farmland and is not considered a scenic vista. Impacts on scenic vistas are anticipated to be minor.

Located 6 miles to the south of the proposed sites is State Route 4, which is designated as a scenic route by both San Joaquin and Contra Costa counties (San Joaquin County 1992, Contra

Costa County 2005); however, these sites would not be visible from this more heavily traveled route.

All visible components of the Proposed Action would be removed after the five-year demonstration period, and disturbed areas would be restored to their pre-project conditions. The levee sheet pile would be cut off 6 inches below the existing grade. No permanent aesthetic impacts on scenic vistas would occur.

Scenic Resources

Both the Old River and Connection Slough sites already have been modified by the addition of riprap-lined levees. Vegetation is regularly cleared from the levees as part of ongoing maintenance; thus, the limited vegetation that is present is not considered a scenic resource. The Proposed Action would not require tree removal, and disturbed areas would be restored to their pre-project condition once construction is completed and after removal of the facilities after the end of the five-year demonstration period. Impacts would be temporary and minor.

Visual Character and Quality

The Proposed Action would not substantially degrade the existing visual character or quality of the proposed sites and their surroundings. As noted above, both river channels have been altered through the addition of rock-lined levees, and the installation of the proposed facilities would affect only a small portion of the rivers. Moreover, all visible facilities would be removed once the five-year demonstration period was completed, and the area would be restored. Impacts would be temporary and minor.

Light and Glare

The operator house would include fluorescent lights. The operator would control three sets of flood lights, providing for both sides of the gates and the boat ramps to be illuminated. The flood lights are the primary source of light, but the light would be directed downward toward gates and boat ramps and would be shielded to reduce visibility from neighboring properties. Exposed bulbs would be prohibited. Channel marker lights would be self-contained solar-powered lights. The proposed lighting would not significantly affect nighttime views in the area, which is largely unpopulated. The nearest occupied structures are the residence and bunkhouse located approximately 0.42 mile northwest of the Connection Slough site and boats at the marina located 0.8 miles south of the Old River site. The ramp surface would consist of precast concrete deck panels to provide access around the proposed facilities for recreational boaters, and the gates would be constructed of steel. The surfaces would not be highly reflective and would not constitute a substantial source of glare that would affect daytime views. No sources of light or glare would be present once the facilities were removed at the end of the five-year demonstration period.

3.2 Agricultural Resources

3.2.1 Environmental Setting

The California Department of Conservation (CDOC) has the primary responsibility for regulation and reporting related to California agricultural lands. The United States Department of Agriculture Natural Resources Conservation Service, formerly the Soil Conservation Service, has defined Important Farmlands based upon a number of factors, including the physical and chemical characteristics of the land and the suitability of the land for producing crops (Table 3.2-1 provides relevant definitions). Important Farmlands are afforded special protection due to their importance to agricultural production.

Table 3.2-1 Important Farmland Definitions

Farmland Category	Definition
Prime Farmland	Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, Prime Farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks.
Unique Farmland	Unique Farmland is land other than Prime Farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods.
Farmland of Statewide Importance	This is land, in addition to Prime and Unique Farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate State agency or agencies. Generally, additional farmlands of statewide importance include those that are nearly Prime Farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as Prime Farmlands if conditions are favorable.
Farmland of Local Importance	In some local areas there is concern for certain additional farmlands for the production of food, feed, fiber, forage, and oilseed crops, even though these lands are not identified as having national or statewide importance. Where appropriate, these lands are to be identified by the local agency or agencies concerned.

Source: CDOC 2007

Note: The definitions for Prime Farmland, Unique Farmland, Farmland of Statewide Importance, and Farmland of Local Importance were developed by the U.S. Department of Agriculture-Soil Conservation Service as part of the nationwide Land Inventory and Monitoring system. The Land Inventory and Monitoring system definitions have been modified for use in California with the most significant modification being that Prime Farmland and Farmland of Statewide Importance must be irrigated.

Both the Old River and Connection Slough sites are bordered by Important Farmland (CDOC 2006, 2008). The portion of Holland Tract that adjoins the Old River site is a combination of Prime Farmland and Farmland of Statewide Importance. Parts of Holland Tract are under cultivation; but in the vicinity of the Old River site, the fields are fallow and are used for cattle grazing. The portion of Bacon Island that is just west of the Old River site contains Prime Farmland and is currently in agricultural production (row crops). The Connection Slough site is bordered by Prime Farmland on Mandeville Island, and by a combination of Prime Farmland, Farmland of Statewide Importance, and Farmland of Local Importance on the Bacon Island side. The latter designation applies to the proposed dredged materials disposal site on Bacon Island. With the exception of this site, the areas surrounding the Connection Slough site are actively farmed with row crops. The lands surrounding the Connection Slough site are under Williamson

Act contracts; those surrounding the Old River site are not. The lands surrounding both sites are zoned for agricultural purposes. The construction area in Contra Costa County just west of Old River is zoned General Agriculture, 5-acre minimum parcel size (A-2). The construction area in San Joaquin County to the east is zoned General Agriculture, 80-acre minimum parcel size (AG-80). The areas on either side of Connection Slough are designated as AG-80. The disposal site at Roberts Island is currently in use as a disposal site and does not contain agricultural resources.

3.2.2 Regulatory Setting

The Farmland Protection Policy Act (7 U.S.C. 4201) is the federal statute that provides the basis for the policy of avoiding impacts on agricultural resources from federal programs. The Act does not prohibit federal agencies from undertaking actions that convert farmland to nonagricultural use, but only requires that they "identify and take into account the adverse effects of federal programs on the preservation of farmland; consider alternative actions, as appropriate, that could lessen such adverse effects; and assure that such federal programs, to the extent practicable, are compatible with state (and local) programs and policies to protect farmland" (7 U.S.C. 4202[b]).

3.2.3 Environmental Consequences

3.2.3.1 No Action Alternative

The No Action alternative would not affect agricultural resources because no development would occur.

3.2.3.2 Proposed Action

Most construction/removal activities would occur in the river channels or on the adjacent banks that are not used for agricultural purposes. About half of the laydown and construction support areas would be located on the levees, while the balance would be in fallow fields at the base of the levees. These areas are not currently in agricultural production. All areas would be returned to their prior condition once initial construction was complete and again after the facilities were removed at end of the five-year demonstration period. The dredged materials disposal site on northeast Bacon Island is classified as Farmland of Local Importance, ,but this site is not actively farmed; moreover, use of this site for storage would not remove soils, and would help offset the land subsidence that results from the decomposition of organic carbon in the peat soils. The Proposed Action would not permanently convert Important Farmland to non-agricultural use at any of the proposed sites.

The Proposed Action would install operable gates on river channels that are occasionally used by farm vessels. Vessel access would be maintained during construction and operations, gate operations are described in Table 2-4. The proposed operations schedule would be publicly available, and farmers also could contact the gate operators directly to determine when the gates were to be closed. Moreover, during March and June when the gates would be closed for longer periods, the Old River gate would be opened at approximately 2-hour intervals for an approximately 15- to 20-minute period, from sunrise to sunset, when boats are present to enable them to pass. This information would be included in the posted schedule. The Connection Slough channel is infrequently used by boats, and therefore these periodic openings are not considered necessary. Thus, farmers needing to go through the gates to access their lands could schedule their trips during periods when the gates were open or use alternative routes. The Proposed

Action would not involve other changes in the existing environment which, due to their location or nature, could result in conversion of Important Farmland to non-agricultural use.

3.3 Air Quality

3.3.1 Affected Environment

3.3.1.1 Introduction

The Old River site is located on the boundary between Contra Costa County, which is in the San Francisco Bay Area Air Basin, and San Joaquin County, which is in the San Joaquin Valley Air Basin. These air basins are under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD) and the San Joaquin Valley Air Pollution Control District (SJVAPCD), respectively. The Connection Slough site is wholly in the San Joaquin Valley Air Basin, as is the Roberts Island #1 disposal site.

State and federal laws define criteria emissions to include the following: reactive or volatile organic compounds (ROC or VOC), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), respirable particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$). During the installation of the proposed components, the Proposed Action would temporarily cause criteria emissions from the combustion of fossil fuels (i.e., diesel, gasoline) used to run construction equipment and vehicles, both onsite and offsite. Installation activities also would cause emissions of fugitive dust, primarily as PM_{10}. During operations, emissions would result primarily from vehicle trips generated by the gate operations and the potential use of diesel-powered generators at each of the proposed sites. Because the Proposed Action would require that PG&E provide electric power, the generators would be used as back-up source of power. However, it may take some time before PG&E is able to connect the facilities to the electric grid, and the generators would be used until this occurred, and as emergency back-ups. The generators would be State-certified under the Portable Equipment Registration Program or permitted pursuant to SJVAPCD regulations.

The potential for impacts on climate change associated with greenhouse gas (GHG) emissions is discussed in Section 3.16.

3.3.1.2 Meteorology

In summer, northwest winds to the west of the Pacific coastline are drawn into the interior through the Golden Gate Bridge and over the lower portions of the San Francisco Peninsula. This channeling of the flow through the Golden Gate Bridge produces a jet of air that sweeps eastward but widens downstream producing southwest winds at Berkeley and northwest winds at San Jose; a branch curves eastward through the Carquinez Strait and into the Central Valley. In winter, the Bay Area experiences periods of storminess and moderate-to-strong winds and periods of stagnation with very light winds. Winter stagnation episodes are characterized by outflow from the Central Valley, nighttime drainage flows in coastal valleys, weak onshore flows in the afternoon and otherwise light and variable winds (BAAQMD n.d.). Annual average wind speeds in the central Bay Area (San Francisco County) are 8.7 miles per hour (mph) or 3.9 meters per second (m/s). Annual average wind speeds in the Stockton area (San Joaquin County) are 7.5 mph or 3.4 m/s, which is typical for the vicinity of the Proposed Action. The climate is

characterized by moderately wet winters and dry summers. About 90 percent of the annual total rainfall is received between November and April period. Between June and September, normal rainfall is typically less than 0.1 inch (BAAQMD n.d.). Temperatures average about 60 degrees Fahrenheit (°F) annually, with summer highs in the 80s and winter lows in the 40s. Precipitation averages about 18 inches per year, although annual precipitation varies markedly from year to year (CSW 2008).

3.3.1.3 Ambient Air Quality

The BAAQMD and SJVAPCD each operate a regional air monitoring network, together comprising over 50 monitoring stations that collectively measure the ambient concentrations of the six criteria air pollutants described above: ozone (O_3), NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$.

Not all monitoring stations are fully instrumented for all the above pollutants. For this assessment, BAAQMD's Bethel Island station data is used as historic and representative since it is located only 4.3 miles northwest (upwind) of the Old River site and monitors all but one pollutant ($PM_{2.5}$), while SJVAPCD's Stockton station is 15 miles east (downwind). Existing and probable future air quality in the vicinity of the Proposed Action can generally be inferred from ambient air quality measurements taken at the Bethel Island site. Table 3.3-1 is a six-year summary of historic monitoring data (2002 to 2007) obtained by the Bethel Island station, except for $PM_{2.5}$. Data on $PM_{2.5}$ are from the BAAQMD's Concord monitoring station (BAAQMD 2008).

During the period from 2002 to 2007, there were no daily violations of state or federal ambient air quality standards for nitrogen dioxide, sulfur dioxide, or carbon monoxide recorded at the Bethel Island station (BAAQMD 2008); however, there were exceedences of ozone, PM_{10} and $PM_{2.5}$ standards. Table 3.3-2 shows the incidence of daily violations of ambient ozone, PM_{10} and $PM_{2.5}$ standards for the six-year period.

Table 3.3-1 Ambient Air Quality Summary for Bethel Island 2002 to 2007, Maximums

Pollutant	Period	Units	2007	2006	2005	2004	2003	2002
Ozone (O_3)	1-hour max	ppmv	0.093	0.116	0.089	0.100	0.090	0.110
	8-hour max	ppmv	0.078	0.090	0.077	0.080	0.080	0.100
	3-year avg	ppmv	0.073	0.073	0.072	0.075	0.079	0.079
Nitrogen Dioxide (NO_2)	1-hour max	ppmv	0.048	0.044	0.038	0.030	0.050	0.040
	Annual avg	ppmv	0.008	0.008	0.007	0.008	0.009	0.010
Sulfur Dioxide (SO_2)	24-hour max	ppmv	0.005	0.007	0.006	0.006	0.006	0.009
	Annual avg	ppmv	0.002	0.002	0.002	0.002	0.002	0.003
Carbon Monoxide (CO)	1-hour max	ppmv	1.1	1.3	1.1	1.2	1.6	1.7
	8-hour max	ppmv	0.8	1.0	0.9	0.9	0.9	1.3
Particulates (as PM_{10})	24-hour max	$\mu g/m^3$	49.0	84.0	64.0	42.0	51.0	58.0
	Annual avg	$\mu g/m^3$	18.8	19.4	18.5	19.5	19.4	23.8
Particulates (as $PM_{2.5}$)	24-hour max	$\mu g/m^3$	46.2	62.1	48.9	74.0	50.0	77.0
	Annual avg	$\mu g/m^3$	8.4	9.3	9.0	10.7	9.7	13.3

Source: BAAQMD 2008

Notes:

Table 3.3-1 Ambient Air Quality Summary for Bethel Island 2002 to 2007, Maximums								
Pollutant	Period	Units	2007	2006	2005	2004	2003	2002
Bethel Island, Concord for $PM_{2.5}$ ppmv = parts per million by volume $\mu g/m3$ = micrograms per cubic meter								

Table 3.3-2 Ozone, PM_{10} and $PM_{2.5}$ Standard Violation Days for Bethel Island, 2002 to 2007								
Pollutant	Standard	Total	2007	2006	2005	2004	2003	2002
Ozone (O_3)	Federal	4	0	1	0	0	0	3
	California	21	4	14	2	1	0	0
Particulates (as PM_{10})	Federal	0	0	0	0	0	0	0
	California	6	0	1	1	0	1	3
Particulates (as $PM_{2.5}$)	Federal	17	7	5	0	1	0	4
	California	0	0	0	0	0	0	0
Source: BAAQMD 2008								

3.3.1.4 Sensitive Receptors

Certain population groups are considered more sensitive to air pollution and odors than others, particularly children, elderly, and acutely ill and chronically ill persons, especially those with cardio-respiratory diseases such as asthma and bronchitis. Sensitive receptors (land uses) indicate locations where such individuals are typically found; e.g., schools, daycare centers, hospitals, convalescent homes, residences of sensitive persons, and parks with active recreational uses, such as youth sports.

Persons engaged in strenuous work or physical exercise also have increased sensitivity to poor air quality. Residential areas are considered more sensitive to air quality conditions than commercial and industrial areas because people generally spend longer periods of time at their residences, resulting in greater exposure to ambient air quality conditions. Recreational uses such as parks are also considered sensitive due to the greater exposure to ambient air quality conditions and because the presence of pollution detracts from the recreational experience.

The Old River, Connection Slough, and Roberts Island #1 disposal sites are located in sparsely populated rural (agricultural) areas. The nearest house is approximately 600 feet (180 meters) south of the Old River site; however, it is unoccupied. The next nearest receptors to the proposed gate sites are a residence and bunkhouse approximately 0.42 mile northwest of the Connection Slough Site and a marina with live-aboard boat owners approximately 0.8 to 1 mile (1,300 to 1,600 meters) south of the Old River site.

3.3.2 Regulatory Setting

3.3.2.1 State and National Ambient Air Quality Standards

The Clean Air Act of 1970 (CAA), (as amended 1977 and 1990, 42 U.S.C. 7401 et seq.) established national ambient air quality standards (NAAQS) and delegates the enforcement of

these standards to the states. In California, the California Air Resources Board (CARB) is responsible for enforcing air pollution regulations. The CARB has in turn delegated the responsibility of regulating stationary emission sources to local air agencies (i.e., BAAQMD and SJVAPCD). In areas that exceed the NAAQS, the CAA requires preparation of a State Implementation Plan (SIP), detailing how the states will attain the standards within mandated time frames. As shown in Table 3.3-3, California ambient air quality standards (CAAQS) tend to be at least as protective as national standards and are often more stringent.

Air districts in California are required to monitor air pollutant levels to assure that NAAQS and CAAQS are met and, in the event that they are not, to develop strategies to meet these standards. Depending on whether the standards are met or exceeded, the local air basin is classified as being in "attainment" or "non-attainment."

The air pollutants of most concern in California are ozone and particulate matter. The San Francisco Bay Area Air Basin (including Contra Cost County) and the San Joaquin Valley Air Basin (including San Joaquin County) are in NAAQS attainment except for the following federal standards shown in Table 3.3-3:

- 8-hour ozone – Non-attainment for both the San Francisco and San Joaquin Valley Air Basins (CARB 2006b).
- 24-hour PM_{10} – Unclassified for the San Francisco Bay Area Air Basin (CARB 2009).
- 24-hour $PM_{2.5}$ – Non-attainment for San Joaquin Valley Air Basin (San Francisco Bay Area Air Basin - Unclassified) (CARB 2006c).
- The San Francisco Bay Area Air Basin is a "Marginal" area for federal 8-hour ozone and originally had to attain the now revoked federal 1-hour ozone standard by 1999.
- The San Joaquin Valley Air Basin is presently a "Serious" and a pending "Severe 17" area for federal 8-hour ozone and nevertheless plans to attain the now revoked federal 1-hour ozone standard by 2010 (see below).

On April 30, 2007, the Governing Board of the SJVAPCD voted to request the U.S. Environmental Protection Agency (EPA) to reclassify the San Joaquin Valley Air Basin as "Extreme" (now referred to as "Severe 17") non-attainment for the federal 8-hour ozone standards. The CARB, on June 14, 2007, approved this request. This request must be forwarded to EPA by the CARB and would become effective upon EPA final rulemaking after a notice and comment process; it is not yet in effect (SJVAPCD 2007).

Effective June 15, 2005, the EPA revoked in the federal 1-hour ozone standard, including associated designations and classifications. However, EPA had previously classified the SJVAB as extreme nonattainment for this standard. Many applicable requirements for extreme 1-hour ozone nonattainment areas continue to apply to the SJVAB (SJVAPCD 2005).

Table 3.3-3 State and Federal Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards		Federal Standards	
		ppmv	µg/m^3	ppmv	µg/m^3
Ozone (O_3)	1-hour	0.09	177	--	--
	8-hour	0.07	137	0.075	147
Nitrogen Dioxide (NO_2)	1-hour	0.18	338	--	--
	Annual	0.03	56	0.053	100
Sulfur Dioxide (SO_2)	1-hour	0.25	655	--	--
	3-hour (secondary)	--	--	0.50	1,309
	24-hour	0.04	105	0.14	367
	Annual	--	--	0.03	79
Carbon Monoxide (CO)	1-hour	20	22,898	35	40,071
	8-hour	9	10,304	9	10,304
	Lake Tahoe (8-hour)	6	6,869	--	--
Particulates (as PM_{10})	24-hour	--	50	--	150
	Annual	--	20	--	--
Particulates (as $PM_{2.5}$)	24-hour	--	--	--	35
	Annual	--	12	--	15
Lead (Pb)	30-day	--	1.5	--	--
	90-day	--	--	--	1.5
Sulfates (as SO_4)	24-hour	--	25	none	none
Hydrogen Sulfide (H_2S)	1-hour	0.03	42	none	none
Vinyl Chloride (C_2H_3Cl)	24-hour	0.01	26	none	none
Visibility Reducing Particles	8-hour	Extinction coefficient of 0.23 per kilometer; visibility of 10 miles or more (0.07 to 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70%.		none	None

Source: CARB 2008

Notes:

Standard Temperature = 25$_o$C

Standard Molar Volume = 24.465 liter/g$_{ram}$-mole

For gases, µg/m3 calculated from ppmv based on molecular weight and standard conditions

ppmv = parts per million by volume

µg/m3 = micrograms per cubic meter

The San Francisco Bay Area and San Joaquin Valley Air Basins are in CAAQS attainment except for the following state standards in Table 3.3-3 (BAAQMD 2008, SJVAPCD 2008):

- 8-hour ozone – Non-attainment
- 1-hour ozone – Non-attainment
- Annual PM_{10} – Non-attainment
- 24-hour PM_{10} – Non-attainment
- Annual $PM_{2.5}$ – Non-attainment
- 1-hour hydrogen sulfide - Unclassified
- 8-hour visibility reducing particles – Unclassified

Similar to the federal CAA, the California CAA also classifies areas according to pollution levels. Under the California CAA, the San Francisco Bay Area Air Basin is a "Serious" state ozone non-attainment area and a state PM_{10} and $PM_{2.5}$ non-attainment area. The San Joaquin Valley Air Basin is presently a "Severe" state ozone non-attainment area, in addition to being a state PM_{10} and $PM_{2.5}$ non-attainment area.

3.3.2.2 Regional Plans

For the San Francisco Bay Area Air Basin, the Association of Bay Area Governments, the Metropolitan Transportation Commission, and BAAQMD jointly prepare the Bay Area Clean Air Plan and Ozone Attainment Plan (BAAQMD 2000, 2001).

For the San Joaquin Valley Air Basin, the Extreme Ozone Attainment Demonstration Plan is prepared by the SJVAPCD, in conjunction with the CARB, the EPA, and the eight regional Transportation Planning Agencies (SJVAPCD 2005).

These plans contain control strategies that demonstrate attainment with the national ambient air quality standards by the deadlines established in the CAA.

3.3.2.3 Air Toxics Control Measures

On July 26, 2007, the CARB adopted a regulation to reduce diesel particulate matter and nitrogen oxide emissions from in use (existing) off-road heavy-duty diesel vehicles in California. The regulation will require fleet owners to accelerate turnover to cleaner engines and install exhaust retrofits.

3.3.2.4 Senate Bill 656

Senate Bill (SB) 656 is a planning requirement that calls for a plan and strategy for reducing $PM_{2.5}$ and PM_{10}. This bill requires the CARB to identify, develop, and adopt a list of control measures to reduce the emissions of $PM_{2.5}$ and PM_{10} from new and existing stationary, mobile, and area sources. The BAAQMD and SJVAPCD have developed particulate matter control measures and submitted plans to the CARB that include lists of measures to reduce particulate matter. Under the plans, the Districts are required to continue to assess $PM_{2.5}$ and PM_{10} emissions and their impacts. For construction emissions of fugitive PM_{10}, the Districts have adopted a number of feasible control measures that can be reasonably implemented to significantly reduce fugitive PM_{10} emissions from construction. In general, the Districts' approach to the analyses of construction impacts is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions.

3.3.2.5 Toxic Air Contaminants

A project with the potential to expose sensitive receptors (including residential areas) or the general public to substantial levels of toxic air contaminants, as designated by the CARB under 17 CCR Section 93001, listed in the BAAQMD 2003 Annual Report Appendix A: Toxic Air Contaminants (BAAQMD 2003), and similarly, in the SJVAPCD 2006 Annual Report on the District's Toxics Program (SJVAPCD 2006), would be deemed to have a significant impact. This includes projects that would locate receptors near existing sources of toxic air contaminants, as well as projects that would place sources of toxic air contaminants near existing receptors.

Proposed projects that have the potential to expose the public to toxic air contaminants in excess of the following thresholds would be considered to have a significant air quality impact. These thresholds, which are based on BAAQMD Regulation 2, Rule 5, New Source Review of Toxic Air Contaminants and SJVAPCD (2002) Assessment Guidance, are as follows:

- Probability of contracting cancer for the Maximally Exposed Individual (MEI) exceeds ten in one million. The MEI is a hypothetical person exposed for 70 years continuously (24 hours per day, 365 days per year).
- Ground-level concentrations of non-carcinogenic toxic air contaminants would result in a Hazard Index greater than one for the MEI.

Diesel particulate matter is considered a toxic air contaminant in California (BAAQMD 2003, SJVAPCD 2006). The impact assessment includes a screening-level Health Risk Assessment for diesel particulate matter impacts on sensitive receptors from construction equipment.

3.3.2.6 General Conformity

Section 176(c) of the CAA contains the General Conformity Rule (40 CFR 51.850-860 and 40 CFR 93.150-160). The General Conformity Rule requires that a federal agency responsible for a proposed action (e.g., the 2-Gates Project) in a NAAQS non-attainment or maintenance area endeavor to ensure that the proposed action conforms to the applicable SIP. This means that federally supported or funded activities shall not: 1) cause or contribute to any new air quality standard violation, 2) increase the frequency or severity of any existing standard violation, or 3) delay the timely attainment of any standard, interim emission reduction, or other milestone. Emissions of attainment pollutants are exempt from the General Conformity Rule. A federal action would comply with an applicable SIP if it does not exceed identified annual emission de minimis thresholds, the magnitudes of which are based on the severity of the non-attainment rating of the region in which the Proposed Action is located. Actions that exceed these thresholds are required to conduct in depth conformity determinations.

Contra Costa and San Joaquin counties are in federal and state non-attainment for ozone, PM_{10}, and $PM_{2.5}$. Thus, the emissions of non-attainment pollutants NO_X, ROC, PM_{10}, and $PM_{2.5}$ would be subject to the General Conformity Rule. As discussed below under Environmental Consequences, emissions from the Proposed Action would be below BAAQMD and SJVAPCD annual thresholds for non-attainment pollutants; thus, the de minimis requirement is satisfied.

3.3.3 Environmental Consequences

3.3.3.1 No Action Alternative

No air quality impacts would result from the No Action alternative because no construction would occur.

3.3.3.2 Proposed Action

The only source of direct emissions during operation of the Proposed Action would be associated with vehicle trips required during infrequent periodic inspections and maintenance activities, personal vehicle trips by the gate operators when the gates are being operated, and the potential temporary use of portable generators at the Old River and Connection Slough sites until power could be obtained from PG&E. Emissions from these sources would be minor and intermittent

and would not result in permanent air quality impacts, nor would they require permits from the BAAQMD or the SJVAPCD. Any impacts from operations would be negligible. The impact assessment focuses on the emissions that would occur as a result of proposed construction activities because these are the main source of emissions.

Methodology

Construction emissions fall into three general categories: 1) onsite use of diesel-powered construction equipment, 2) onsite controlled (mitigated) fugitive dust generation from demolition and earthmoving activities, and 3) offsite vehicle traffic comprising project-related trucking and project worker commuting. Construction-related emissions are generally short-term in duration, but may still cause localized adverse air quality impacts. Specific to this type of project, dredging and pile driving equipment would be permitted pursuant to SJVAPCD regulations.

The analysis of the Proposed Action's air quality impacts is based on equipment specifications and planning estimates for the construction (installation) phase of the Proposed Action as listed in Tables 3.3-4 and 3.3-5, respectively. A detailed air impact analysis associated with the complete removal of all components at the end of the demonstration period is not included because emissions would be less than those required for installation (the removal period would last only 4 weeks, as opposed to approximately 21 weeks for construction, less equipment would be required [e.g., no dredging would be needed], and some of the rock would be left in the channel bottom, thus requiring less movement of materials).

Table 3.3-4 Construction Estimated Equipment List

Equipment Type	Manufacturer/Model	Quantity	Horsepower
Off-Road Construction (onsite)			
Loader	CAT 966G	2	233
Forklift	CAT TH83	2	109
Excavator	CAT 330	2	268
On-Road Vehicles (offsite)			
Grove Boom Truck RT 522	RT 522	1	150
Flat Bed Truck	Chevy	1	250
Pick Up Truck	Chevy/Silverado	4	200
Fuel/Service Truck	Kenworth	1	225
Water Truck (3600 gallons)	Kenworth	1	400
Marine Vessels and Equipment (onsite)			
DB 24 (with Amclyde 28 crane)	CAT 3412	1	525
Dump Scow 5 (hopper barge)	CAT 3208	2	210
CB 8 (with Bucyrus-Erie 88B crane)	Cummins V1710	1	365
CB Doolittle (with Bucyrus-Erie 65D crane)	Cummins 855	1	280
Workboat	John Deer 400	3	600
Tugboat "Sarah Reed"	Cummins KTA38	2	1700
Generator 25KW	Rental	4	35
Vibratory / Impact Hammer	APE 200/CAT C16	1	630
Flat Deck Material Barge	n/a	6	
Dredged Material Disposal (offsite)			
Tugboat for Dredged Material Barge	Charter	2	800

Table 3.3-4 Construction Estimated Equipment List			
Equipment Type	Manufacturer/Model	Quantity	Horsepower
Offloading Crane	Rental	1	750
D6 Dozer	Caterpillar D6	1	200
Barge for Dredged Material	n/a	3	
Source: Dutra Group 2008 (updated 2009)			

Table 3.3-5 Construction Planning Estimate					
Project Activity	Schedule				
	hours/day	days/week	weeks	days	hours
Land-Side Sheet Pile Driving	8	5	3.2	16	128
Submerged Sheet Pile Driving	12	5	7.6	38	456
Dredging & Spoils Disposal	12	5	4.4	22	264
Gravel Bedding Fill Placement	12	5	4.6	23	276
Rock Locking Fill Placement	12	5	6.6	33	396
Vessels Tending (concurrent)	12	5	19.4	97	1164
Totals (with activity overlaps)	**12**	**5**	**19**	**97**	
Source: Moffat & Nichol September 24, 2009					

Combustion Emissions. Table 3.3-6 shows estimated maximum fuel consumption for the Proposed Action based on equipment specifications and planning estimates for the site preparation and construction activities provided by the contractor, assuming a brake specific fuel consumption (BSFC) of 0.051 gallons (gal) per brake horsepower-hour (BHP-hr) (AP-42, Table 3.3-1) (EPA 2006). If actual fuel consumption is lower, there would be correspondingly lower emissions. California ultra-low sulfur diesel fuel with a maximum sulfur content of 15 parts per million (ppm) by weight would be used in all diesel-powered equipment to minimize sulfur dioxide and particulate emissions.

Table 3.3-6 Estimated Maximum Fuel Consumption			
Project Activity	Hourly	Daily	Project
	gal/hour	gal/day	gallons
Onsite Preparation and Construction	130	1,400	76,000
Offsite Preparation	80	990	19,900
Maximum Impact Totals	**130**	**1,400**	**95,900**
Source: M&N September 24, 2009			
Notes: Maximum onsite hourly and daily rates for concurrent activities BSFC = (7,000 British thermal units [BTU]/BHP-hr) / (137,030 BTU/gal) = 0.051 gal/BHP-hr AP-42 Table 3.3-1 (EPA 2006)			

Combustion emissions were estimated using the emission factors given in Table 3.3-7 for diesel nonroad equipment. For calculating emissions, EPA Tiered emission factors (40 CFR 89.112 & 13 CCR 2423) in grams per BHP-hr were converted to pounds per thousand gallons (lb/mgal) burned, assuming a diesel default heat rate of 7,000 British thermal units (BTU) per BHP-hr and a higher heating value of 137,030 BTU per gallon (AP-42, Table 3.3-1) (EPA 2006). Average engine age (Tier) was estimated based on Annex 3, Table A-101 and Table A-84, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007 (EPA 2009). The age analysis yielded an estimated distribution of 31 percent Tier 3, 28 percent Tier 2, 19 percent Tier 1, and 22 percent Uncontrolled for 2010. The use of newer, less polluting Tier 1, 2, and 3 engines in the majority of construction equipment used onsite is a mitigating factor for combustion emissions of NO_X, ROC, CO, PM_{10}, and $PM_{2.5}$.

Fugitive Dust Emissions. PM_{10} in the form of fugitive dust is the pollutant of greatest concern with respect to construction activities. Fugitive PM_{10} emissions can result from a variety of construction activities, including excavation, grading, demolition, vehicle travel on paved and unpaved surfaces, and vehicle and equipment exhaust. Construction-related emissions, including site preparation, can cause substantial increases in localized concentrations of PM_{10}. Particulate emissions from construction activities can lead to adverse health effects as well as nuisance concerns such as reduced visibility and soiling of exposed surfaces.

Table 3.3-7 Tiered Nonroad Diesel Emission Factors, Pounds per 1000 Gallons

Emittent	Pre-control lb/mgal	Tier 1 (96) lb/mgal	Tier 2 (01) lb/mgal	Tier 3 (06) lb/mgal	Composite lb/mgal
Oxides of Nitrogen (as NO_2)	604.2	297.8	181.3	112.2	276.2
Hydrocarbons (ROC as CH_4)	47.5	43.2	25.9	17.3	30.2
Carbon Monoxide (CO)	129.5	366.8	112.2	112.2	164.0
Particulates (as PM_{10})	43.2	17.3	6.5	6.5	17.3
Sulfur Dioxide (SO_2)	0.2	0.2	0.2	0.2	0.2
Carbon Dioxide (GHG - CO_2)	22,485	22,485	22,485	22,485	22,485
Nitrous Oxide (GHG - N_2O)	0.6	0.6	0.6	0.6	0.6
Methane (GHG - CH_4)	1.3	1.3	1.3	1.3	1.3

Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007, EPA 2009; 40 CFR 89.112; 13 CCR 2423

Notes:
Nonroad Tier 1, 2, 3 per 40 CFR 89.112 & 13 CCR 2423
Precontrol NO_X, ROC, CO, PM_{10} per AP-42 Table 3.3-1
2010 engine age profile estimation based on Annex 3, Table A-101, Table A-84, US GHG Inventory
22% Precontrol (uncontrolled)
19% Tier 1
28% Tier 2
31% Tier 3
Default heat rate = 7,000 BTU/BHP-hr (AP-42 Table 3.3-1)
Diesel = 19,300 BTU/lb, 7.1 lb/gal (AP-42 Table 3.3-1)

Construction areas on Bacon Island, the Holland Tract, and Connection Slough would comprise 4.13, 4.13, and 2.75 acres, respectively, for a total of 11.02 acres. These areas were used to estimate fugitive dust emissions using the BAAQMD and SJVAPCD protocol described below. Offsite disposal of excess dredged material on Roberts Island could also involve an area of up to 4.13 acres.

Construction emissions of fugitive PM_{10} can vary greatly depending on the level of activity, the specific operations taking place, the equipment being operated, local soils, weather conditions, and other factors. Despite this variability in emissions, experience has shown that there are a number of feasible control measures that can be reasonably implemented to significantly reduce fugitive PM_{10} emissions from construction. The Districts' approach to environmental analyses of construction impacts is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions.

For land disturbance, fugitive dust (as PM_{10}) was estimated as 51 pounds per acre per day unmitigated (uncontrolled) as specified in the BAAQMD guidelines (BAAQMD 1999), consistent with SJVAPCD Assessment Guidelines (SJVAPCD 2002), Section 3.3; AP-42 Chapter 13.2.3 "Heavy Construction Operations"; and AP-42 Chapter 13.2.2 "Unpaved Roads," Figure 13.2.2-2 (EPA 2006). For the BAAQMD and SJVAPCD control measures listed in Section 3.3.3.3 below, an equivalent soil to moisture ratio of 5:1 was assumed for all feasible measures, which reduces fugitive dust emissions by 95 percent from uncontrolled levels.

Offsite Vehicle Emissions. A relatively small source of emissions compared to onsite equipment, offsite vehicle emissions consist of worker commute trips in light-duty vehicles (passenger cars and light trucks) to and from the proposed sites, and heavy-duty truck emissions generally associated with hauling away debris and transporting materials and equipment to the site. Commuter trip estimates were developed using the generalized emissions estimation methodology given in the BAAQMD (1999) guidelines, Section 3.4, Tables 10 and 11. Similarly, heavy-duty truck trip estimates were developed and translated into emissions utilizing CARB's EMFAC 2007 computer program (i.e., determination of emission factors).

Dispersion Modeling. For onsite emissions, EPA's SCREEN Version 96043 (EPA 1992) was used to model the Gaussian dispersion of emissions to obtain ambient impacts. For combustion emissions from construction equipment, a single equivalent point source (stack) was modeled to yield maximum potential downwind impact from the construction site, which is highly conservative and thus tends to overestimate impacts. Fugitive dust emissions were modeled as an equilateral area source with zero release height, which is also conservative and thus tends to overestimate impacts. For screening dispersion modeling, the annual average wind speed of 3.6 m/s (NOAA 2008) was assumed for neutral Stability Class D.

Appendix E, Air Quality Calculations, includes detailed calculation and modeling templates.

Effects of the Proposed Action

The Proposed Action would generate PM_{10} and $PM_{2.5}$, primarily through fugitive dust (PM_{10}) emissions during construction activities, and from PM_{10} and $PM_{2.5}$ emissions from diesel-powered construction equipment. The BAAQMD and SJVAPCD significance criteria for ozone precursors (NO_X and ROC) and PM_{10} emitted from proposed activities are shown in Tables 3.3-8 and 3.3-9, respectively. For CO emissions, significance is defined as causing a violation of the state standard for CO of 9 ppm averaged over 8 hours or 20 ppm for 1 hour (BAAQMD 1999, SJVAPCD 2002).

Table 3.3-8 BAAQMD Thresholds		
	Total Project	
Significance Criteria	tons/year	lbs/day
Oxides of Nitrogen (as NO_2)	15	80
Hydrocarbons (ROC as CH_4)	15	80
Particulates (as PM_{10})	15	80
Carbon Monoxide (CO)	Violation of CAAQS for CO	
Source: BAAQMD CEQA Guidelines, Table 3 (BAAQMD 1999)		

Table 3.3-9 SJVAPCD Thresholds		
	Total Project	
Significance Criteria	tons/year	lbs/day
Oxides of Nitrogen (as NO_2)	10	n/a
Hydrocarbons (ROC as CH_4)	10	n/a
Carbon Monoxide (CO)	Violation of CAAQS for CO	
Source: Guide for Assessing and Mitigating Air Quality Impacts, Table 3-1 (SJVAPCD 2002)		

A preliminary screening impact analysis was performed, estimating the controlled[1] onsite, offsite, and total emissions from construction activities. The results are summarized in Tables 3.3-10, 3.3-11, and 3.3-12, respectively.

Table 3.3-10 Estimated Onsite Construction Criteria Emissions, Controlled			
Project Emissions	tons	lb/day	lb/hour
Oxides of Nitrogen (as NO_2)	10.50	385.30	35.33
Hydrocarbons (ROC as CH_4)	1.15	42.13	3.86
Carbon Monoxide (CO)	6.23	228.78	20.98
Particulates (as PM_{10})	0.66	24.13	2.21
Sulfur Dioxide (SO_2)	0.01	0.28	0.03
Carbon Dioxide (GHG - CO_2)	854	31,366	2,876
Nitrous Oxide (GHG - N_2O)	0.02	0.84	0.08
Methane (GHG - CH_4)	0.05	1.81	0.17
Diesel Particulate Matter (DPM)	0.66	24.13	2.21
Fugitive Dust (as PM_{10})	1.36	28.10	2.34

[1] "Controlled" means implementation of BAAQMD and/or SJVAPCD required emissions control measures. These measures are in Section 3.3.3.3.

Table 3.3-11 Estimated Offsite Construction Criteria Emissions, Controlled			
Project Emissions	tons	lb/day	lb/hour
Oxides of Nitrogen (as NO_2)	3.19	283.49	25.25
Hydrocarbons (ROC as CH_4)	0.36	31.31	2.85
Carbon Monoxide (CO)	2.67	184.29	19.25
Particulates (as PM_{10})	0.29	19.66	2.06
Sulfur Dioxide (SO_2)	0.01	0.37	0.06
Carbon Dioxide (GHG - CO_2)	343	24,795	2,483
Nitrous Oxide (GHG - N_2O)	0.01	0.63	0.06
Methane (GHG - CH_4)	0.02	1.39	0.13
Diesel Particulate Matter (DPM)	0.18	17.33	1.47
Fugitive Dust (as PM_{10})	3.28	75.91	17.22

Table 3.3-12 Estimated Total Construction Criteria Emissions, Controlled			
Project Emissions	tons	lb/day	lb/hour
Oxides of Nitrogen (as NO_2)	13.69	668.79	60.58
Hydrocarbons (ROC as CH_4)	1.51	73.44	6.72
Carbon Monoxide (CO)	8.90	413.07	40.23
Particulates (as PM_{10})	0.95	43.79	4.27
Sulfur Dioxide (SO_2)	0.02	0.65	0.09
Carbon Dioxide (GHG - CO_2)	1,197	56,161	5,359
Nitrous Oxide (GHG - N_2O)	0.03	1.46	0.13
Methane (GHG - CH_4)	0.07	3.20	0.30
Diesel Particulate Matter (DPM)	0.84	41.47	3.69
Fugitive Dust (as PM_{10})	4.64	104.01	19.56

Although no BAAQMD or SJVAPCD annual thresholds would be exceeded, daily emissions of NO_X and combined daily emissions of PM_{10} (i.e., combustion plus fugitive dust) are over the BAAQMD threshold. Since Contra Costa and San Joaquin counties are in non-attainment for PM_{10} and $PM_{2.5}$, screening dispersion modeling was performed to determine whether state or federal ambient air quality standards would be exceeded solely due to proposed activities against historic maximum background levels, including carbon monoxide. The screening air quality impacts are shown in Table 3.3-13. A screening risk evaluation for diesel particulate matter for the construction period is shown in Table 3.3-14.

The results of the screening analysis for criteria pollutants show that no exceedence of ambient air quality standards in the vicinity of the Proposed Action would result solely from proposed activities. Notwithstanding impacts from the Proposed Action, maximum background levels of particulate matter (PM_{10}, $PM_{2.5}$) already exceed state or federal standards as applicable in the vicinity. Therefore, the Proposed Action would contribute to these existing exceedences. The BAAQMD and SJVAPCD developed the following emission control measures for construction

emissions that, when implemented, would prevent significant contributions of emissions, thus mitigating impacts.

Table 3.3-13 Estimated Onsite Construction Criteria Maximum Impacts, Controlled

Criteria Pollutant	Averaging Period	Modeled	Back-ground	Total	California Standard		Federal Standard	
		ug/m^3	ug/m^3	ug/m^3	ug/m^3	status	ug/m^3	status
Nitrogen Dioxide (NO_2)	1-hour max	16.8	94	111	338	Under	---	Under
	Annual avg	0.4	19	19	56	Under	100	Under
Sulfur Dioxide (SO_2)	1-hour max	0.0	59	59	655	Under	---	Under
	3-hour	0.0	53	53	---	Under	1309	Under
	24-hour	0.0	24	24	105	Under	367	Under
	Annual avg	0.0	7	7	---	Under	79	Under
Carbon Monoxide (CO)	1-hour max	19.5	1,946	1,966	22,898	Under	40,071	Under
	8-hour	13.7	1,488	1,502	10,304	Under	10,304	Under
Particulates (as PM_{10})	24-hour	0.41	84.0	84.4	50	Exceed	150	Under
	Annual avg	0.04	23.8	23.8	20	Exceed	---	Under
Particulates (as $PM_{2.5}$)	24-hour	0.41	77.0	77.4	---	Under	35	Exceed
	Annual avg	0.04	13.3	13.3	12	Exceed	15	Under
Fugitive Dust (as PM_{10})	24-hour	18.37	84.0	102.4	50	Exceed	150	Under
	Annual avg	1.95	23.8	25.8	20	Exceed	---	Under

Source: BAAQMD 2008, CARB 2008

Notes:

Background reference is Bethel Island 2002-07 (Concord for $PM_{2.5}$)

Combustion emissions maximum impact at 1191 m (3907 ft), point or volume source.

Fugitive dust maximum impact at 158 m (518 ft), area source.

ug/m^3 = micrograms per cubic meter

Table 3.3-14 Diesel Particulate Matter Screening Health Risk Assessment

Pollutant	Annual	URV	Activity	Annual MEI	Cancer
	ug/m^3	(ug/m^3)$^{-1}$	days	Correction	Risk
Diesel Particulate Matter (DPM)	0.04	3.00E-04	97	0.0038	5.0E-08

Source: California EPA, Office of Environmental Health Hazard Assessment, 2005

Notes:

Sensitive receptor impact at 1288 m (4226 ft), point or volume source.

ug/m^3 = micrograms per cubic meter

URV = Unit Reference (Risk) Value

Diesel Emissions Control Measures

The following requirements would be incorporated into contract specifications:

- To minimize potential diesel odor impacts on nearby receptors (pursuant to BAAQMD Regulation 1, Rule 301, and SJVAPCD Regulation IV, Rule 4102, Nuisance), construction equipment will be properly tuned. A schedule of tune-ups will be developed and performed for all equipment. A log of required tune-ups will be maintained and a copy of the log will be submitted to the Project Environmental Compliance Officer for review every 2,000 service hours.
- Fixed temporary sources of air emissions (such as portable pumps, compressors, generators, etc.) will be electrically powered unless the contractor submits documentation and receives approval from the Project Environmental Compliance Officer that the use of such equipment is not practical, feasible, or available (generally contingent upon power line proximity, capacity, and accessibility). California ultra-low sulfur diesel fuel with maximum sulfur content of 15 ppm by weight, or an approved alternative fuel, will be used for onsite fixed equipment not using line power.
- To minimize diesel emission impacts, construction contracts will require off-road compression ignition equipment operators to reduce unnecessary idling with a two-minute time limit.
- On-road and off-road material hauling vehicles will shut off engines while queuing for loading and unloading for time periods longer that two minutes.
- Off-road diesel equipment will be fitted with verified diesel emission control systems (e.g., diesel oxidation catalysts) to the extent reasonably and economically feasible.
- Utilize alternative fuel equipment (i.e., compressed or liquefied natural gas, biodiesel, electric) to the extent reasonably and economically feasible.

Construction emissions of fugitive PM_{10} can vary greatly depending on the level of activity, the specific operations taking place, the equipment being operated, local soils, weather conditions, and other factors. Despite this variability in emissions, experience has shown that there are a number of feasible control measures that can be reasonably implemented to significantly reduce fugitive PM_{10} emissions from construction. The Districts' approach to the analysis of construction impacts is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions.

Dust Control Measures

To control emissions of particulate matter, the Proposed Action would implement the following fugitive dust and particulate matter emissions control measures suggested by the BAAQMD CEQA and SJVAPCD Assessment Guidelines as applicable (BAAQMD 1999, SJVAPCD 2002). The following controls would be implemented at the construction and staging sites as applicable.

- Water all active construction areas at least twice daily as necessary and indicated by soil and air conditions.

- Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least two feet of freeboard.
- Pave, apply water three times daily, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
- Sweep daily (with water sweepers) all paved access roads, parking areas and staging areas at construction sites.
- Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets.
- All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, will be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, covered with a tarp or other suitable cover or vegetative ground cover.
- All on-site unpaved roads and off-site unpaved access roads will be effectively stabilized of dust emissions using water or chemical stabilizer/suppressant.
- All land clearing, grubbing, scraping, excavation, land leveling, grading, cut & fill, and demolition activities will be effectively controlled of fugitive dust emissions utilizing application of water or by presoaking.
- When materials are transported off-site, all material will be covered, or effectively wetted to limit visible dust emissions, and at least 6 inches of freeboard space from the top of the container will be maintained.
- All operations will limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at the end of each workday. The use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions. Use of blower devices is expressly forbidden.
- Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles will be effectively stabilized of fugitive dust emissions utilizing sufficient water or chemical stabilizer/suppressant.

The estimated effectiveness of these control measures is quantified in Table 3.3-15.

Table 3.3-15 Estimated Fugitive Dust Emissions from Construction

Sheet Pile	Area	Schedule	Control	Uncontrolled		Controlled	
	acres	days	percent	lbs/day	lbs/year	lbs/day	lbs/year
Bacon Island	4.13	97	95%	211	20,442	11	1,022
Holland Tract	4.13	97	95%	211	20,442	11	1,022
Connection Slough	2.75	97	95%	140	13,628	7	681
Onsite Totals	**11.02**	**97**		**562**	**54,512**	**28**	**2,726**
Roberts Island	4.13	20	95%	211	4,215	11	211
Offsite Totals	**4.13**	**20**		**211**	**4,215**	**11**	**211**

Sources: BAAQMD 1999, EPA 2006

Notes:

Fugitive dust (as PM_{10}) 51 lb/acre-day unmitigated, BAAQMD CEQA Guidelines, Section 3.3

BAAQMD Ref: AP-42 Chapter 13.2.3 "Heavy Construction Operations"

Mitigation Ref: AP-42 Chapter 13.2.2 "Unpaved Roads", Figure 13.2.2-2

Soil moisture ratio = 5 (for all feasible mitigation measures under project control)

Roberts Island soil moisture ratio = 5 (for permitted mitigation measures)

Diesel Particulate Matter Emissions Control Measures

The following measures would be implemented to reduce particulate matter emissions from diesel exhaust:

- Grid power will be used instead of diesel generators where it is feasible to connect to grid power (generally contingent upon power line proximity, capacity, and accessibility).
- Specifications will include 13 CCR Sections 2480 and 2485, which limit the idling of all diesel-fueled commercial vehicles (weighing over 10,000 pounds, both California- or non California-based trucks) to 30 seconds at a school or five minutes at any location. In addition, the use of diesel auxiliary power systems and main engines will be limited to five minutes when within 100 feet of homes or schools while the driver is resting.
- Specifications will include 17 CCR Section 93115, Airborne Toxic Control Measure for Stationary Compression Ignition Engines, which specifies fuel and fuel additive requirements; emission standards for operation of any stationary, diesel-fueled, compression-ignition engines; and operation restrictions within 500 feet of school grounds when school is in session.
- A schedule of low-emissions tune-ups will be developed and such tune-ups will be performed on all equipment, particularly for haul and delivery trucks.
- Low-sulfur (maximum sulfur content of 15 ppm by weight) fuels will be used in all stationary and mobile equipment.

Construction emissions are transient and temporary, and BAAQMD and SJVAPCD control measures would be implemented as described previously. The Proposed Action would not expose sensitive receptors to substantial pollutant concentrations. The proposed sites are located in a sparsely populated rural (agricultural) area. The nearest house is approximately 600 feet (180 meters) south of the Old River site; however, it is unoccupied. The next nearest receptor is a

marina with live-aboard boat owners approximately 0.8 mile south (1,300 meters) of the Old River site. It is not known whether the marina, which is outside the immediate vicinity (i.e., 1000 feet or 305 meters) of the Old River site, houses potentially sensitive persons.

Construction activities would cause short-term emissions of NO_X, ROC, CO, SO_2, PM_{10}, and $PM_{2.5}$ from diesel-powered equipment and earthmoving (ground disturbance). The results of the screening analysis described above shows that no exceedence of ambient air quality standards in the vicinity of the Proposed Action would result solely from proposed activities. Notwithstanding impacts from the Proposed Action, maximum background levels of particulate matter (PM_{10}, $PM_{2.5}$) already exceed applicable state or federal standards.

Diesel particulate matter contain substances that are suspected carcinogens, along with pulmonary irritants and hazardous compounds that may affect sensitive receptors such as young children, senior citizens, or those susceptible to respiratory disease. Where construction activity occurs in proximity to long-term sensitive receptors, there could be a potential for unhealthful exposure of those receptors to diesel exhaust, including residential receptors. The results of the screening risk assessment analyses show that the probability of contracting cancer from diesel particulate matter, for the MEI is about 5×10^{-8}, which is 200 times less than the 10 in one million (1×10^{-5}) BAAQMD or SJVAPCD threshold.

California ultra-low sulfur diesel fuel with a maximum sulfur content of 15 ppm by weight would be used in all diesel-powered equipment which minimizes emissions of sulfurous gases (sulfur dioxide, hydrogen sulfide, carbon disulfide, and carbonyl sulfide). Moreover, the proposed sites are located in an unpopulated area, and the nearest area potentially containing sensitive receptors is approximately 0.8 mile from the Old River site. Therefore, no objectionable odors are anticipated from construction activities or normal operation of the Proposed Action.

3.4 Aquatic Biological Resources

This section addresses aquatic biological resources. Terrestrial biological resources are addressed in Section 3.5.

3.4.1 Affected Environment

3.4.1.1 Overview

The Delta formerly was a dynamic ecosystem dominated by riverine inflow over an extensive tidal freshwater area supporting vast marsh landscapes. It has been transformed to one characterized by dampened hydrodynamic variability and highly altered marsh and river channel habitat. The present fish fauna of the Delta includes both migratory and resident species (Table 3.4.1).

The proposed gates would be installed in Old River and Connection Slough, just south of Franks Tract. Old River is a distributary channel of the San Joaquin River. The section of Connection Slough selected for the gate location is in a constructed channel that connects Middle River to a slough of Old River. Old River and Middle River are major conduits for SWP and CVP export flows in the Delta.

3.4.1.2 Phytoplankton and Primary Production

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 (Lund et al. 2007, Baxter et al. 2008). These changes, as well as the collapse of several Delta fish populations (known as the Pelagic Organism Decline [POD] are the subject of an intensive scientific investigation (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. Phytoplankton also may be a very important component of the food web for sensitive fish in the Delta (Jassby et al. 2003, Durand 2008). Detrital cycling of carbon and biologically available energy also may contribute to the food web (Sobczak et al 2002, Durand 2008).

Primary productivity in the San Francisco Estuary is limited primarily by light penetration and benthic grazing by the clam *Corbula*. Several investigators have evaluated the role of various physical factors, nutrients and pollutants on phytoplankton productivity and occurrence in the Delta and adjacent waters of the San Francisco Estuary. Generally, primary productivity is low in the winter when winter storms move more turbid water into the Delta while solar illumination levels and water temperatures are low (Jassby 2008). Phytoplankton productivity increases in the spring, generally starting in March or April. Spring blooms of diatoms are frequently replaced by green and blue-green filamentous algae in the later spring through summer (Lehman 2007).

3.4.1.3 Zooplankton

Zooplankton are planktonic animals unable to swim against tidal or riverine currents. Zooplankton in the Delta are composed of a wide variety of microzooplankton (e.g., calanoid and cyclopoid copepods, rotifers), mesozooplankton, and macrozooplankton (e.g. mysid shrimp, amphipods).

Zooplankton are a primary consumers of phytoplankton in the Delta ecosystem and are frequently the sole prey item for fish larvae of most species. Mysid shrimp rely on phytoplankton during early life stages. Likewise, zooplankton are an important food source for many fish in the Delta. Therefore, they are a key component of the estuarine food chain, supporting larger fish and macroinvertebrates. The community structure of Delta zooplankton has been significantly modified by introduced species.

3.4.1.4 Benthic and Epibenthic Invertebrates

Benthic macroinvertebrates, such as polychaete and oligochaete worms, are bottom-dwelling animals that generally live within the top foot of sediment in the Delta. Epibenthic invertebrates, such as shrimp, amphipods, crabs, bivalve mollusks and crayfish, 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 and salinity). Burgeoning populations of introduced bivalves, such as the overbite clam (Corbula amurensis) and the Asiatic clam (Corbicula fluminea), can filter phytoplankton from the water column.

3.4.1.5 Aquatic Weeds

Aquatic macrophytes, such as water hyacinth (Eichhornia crassipes) and Brazilian waterweed (Egeria densa), both invasive exotic plants, are two of the more dominant aquatic weeds found in the Delta. Most of the aquatic plants are rooted, with the exception of the water hyacinth, which is a free-floating plant. Submerged Aquatic Vegetation (SAV) can be an important form of

habitat providing cover for young fish or ambush sites for predatory fish. Recent work has shown that SAV provides productive rearing habitat for fishes in the Delta (Grimaldo et al. 2004; Nobriga et al. 2005). The spread of Brazilian waterweed has expanded since the 1980s, while the relative abundance of native fish species has declined (Brown and Michniuk 2007) along with an increase in abundance of centrarchids. Native fishes are very rare in SAV-dominated habitats within the Delta (Brown 2003; Feyrer and Healey 2003; Grimaldo et al. 2004; Nobriga et al. 2005; Brown and Michniuk 2007). Brazilian waterweed grows in dense stands that strongly affect local water quality and have likely contributed to reduced turbidity in the Delta.

3.4.1.6 Fish

Common species expected to occur at the gate sites and in the region of influence include those associated with SAV, such as centrarchids, and other common demersal species found in the south Delta channels, such as white catfish and channel catfish. Threadfin shad, common carp, and other non-native species are also frequently encountered in the south Delta and are expected to occur near the gates in relatively high large numbers.

Introduced fish species now make up the majority of individuals (diversity and numerical composition) collected in monitoring and research studies of the Delta. These introductions have significantly altered the function of the ecosystem with respect to predator-prey dynamics and food web pathways. Multiple studies show that striped bass are primary predators of small fishes in channel and littoral areas, whereas largemouth bass are predators of fishes in littoral areas.

Table 3.4-1 Fishes that Occur in the Delta and Central Valley Rivers

Common Name	Scientific Name	Native	Location	
			Delta	Central Valley Rivers
Pacific lamprey	*Lampetra tridentata*	●	●	●
River lamprey	*Lampetra ayersi*	●	●	●
Chinook salmon	*Oncorhynchus tshawytscha*	●	●	●
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*	●	●	●
Sacramento splittail	*Pogonichthys macrolepidotus*	●	●	●
Sacramento blackfish	*Orthodon microlepidotus*	●	●	●
Hardhead	*Mylopharodon conocephalus*	●	●	●
Hitch	*Lavinia exilicauda*	●	●	●
Golden shiner	*Notemigonus crysoleucas*		●	●
Fathead minnow	*Pimephales promelas*		●	●

Table 3.4-1 Fishes that Occur in the Delta and Central Valley Rivers				
			Location	
Common Name	Scientific Name	Native	Delta	Central Valley Rivers
Goldfish	*Carassius auratus*		●	●
Common carp	*Cyprinus carpio*		●	●
Threadfin shad	*Dorosoma petenense*		●	●
American shad	*Alosa sapidissima*		●	●
Black bullhead	*Ameiurus melas*		●	●
Brown bullhead	*Ameiurus nebulosus*		●	●
White catfish	*Ameiurus catus*		●	●
Channel catfish	*Ictalurus punctatus*		●	●
Western mosquitofish	*Gambusia affinis*		●	●
Inland silverside	*Menidia beryllina*		●	●
Three-spined stickleback	*Gasterosteus aculeatus*	●	●	●
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 dolomieu*		●	●
Bigscale logperch	*Percina macrolepida*		●	●
Yellowfin goby	*Acanthogobius flavimanus*		●	●
Chameleon goby	*Tridentiger trigonocephalus*		●	●
Prickly sculpin	*Cottus asper*	●	●	●
Tule perch	*Hysterocarpus traskii*	●	●	●
Starry flounder	*Platichthys stellatus*	●	●	

Source: Moyle 2002

3.4.1.7 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 the California Endangered Species Act (CESA) or by the California Fish and Game Code section relating to fully protected species.

Table 3.4-2 summarizes the special-status aquatic species expected to occur at the proposed sites. Splittail is a state and federal species of special concern

Table 3.4-2 Potentially Affected State and Federally Listed Fishes

Common Name	Scientific Name	Listing Status[1]		Critical Habitat in Central Delta	Essential Fish Habitat
		Federal	State		
Delta smelt	*Hypomesus transpacificus*	FT	SE	Yes	N/A
Longfin smelt	*Spirinchus thaleichthys*		ST	N/A	N/A
North American green sturgeon	*Acipenser medirostris*	FE		Yes	
Sacramento River winter-run Chinook salmon	*Oncorhynchus tshawytscha*	FE	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*	SC	SSC	N/A	Yes

Source: Data compiled by ENTRIX in 2009 from NMFS, USFWS and DFG's State and Federally Listed Endangered & Threatened Animals of California, July 2009.

[1]Listing status definitions: FT = federally listed as threatened; FE = federally listed as endangered; SC = federal species of concern; SE = State Endangered; ST = State Threatened; SSC = State Species of Special Concern; N/A = not applicable.

3.4.1.8 Critical Habitat

Under the federal ESA, the tidal extent of the Delta has been designated critical habitat for delta smelt, and Central Valley steelhead for migration and juvenile rearing habitat, and it is proposed critical habitat for green sturgeon. The Sacramento River along the north side of the Delta is designated as critical habitat for winter- and spring-run Chinook salmon. Thus, critical habitat designated for winter-run (NMFS 1993) and spring-run Chinook salmon (NMFS 2005) does not include the proposed Old River and Connection Slough sites. 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 that are not currently occupied by a 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.

3.4.1.9 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 U.S.C. 1802[10]). The Pacific Fisheries Management Council designated EFH in their management plans. Two fishery management plans cover species that occur in the area where the Proposed Action would be located and include the Delta as EFH. Chinook salmon is 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 Proposed Action, EFH is designated for fall-run Chinook salmon (adult migration and holding, juvenile migration, and possibly juvenile rearing) and late fall-run Chinook salmon (intermittent adult holding or juvenile rearing). The area where the Proposed Action would be implemented does not include EFH for winter-run or spring-run Chinook salmon, which utilize the Sacramento River Basin. Starry flounder is covered under the Groundfish Management Plan; but EFH designated for starry flounder does not include habitat in the Delta.

3.4.1.10 Biological Characteristic of Potentially Affected Sensitive Species

The following section provides a brief summary of the biological characteristics of sensitive aquatic species that could be affected by the Proposed Action.

Delta Smelt

The delta smelt is an endemic species that is most abundant in the low salinity zone of the estuary. There has been a long-term decline in the abundance of delta smelt, with persistent record or near-record lows observed since 2000.

Delta smelt are slender-bodied fish, about 2 to 3 inches long, in the Osmeridae family (smelts). Delta smelt are euryhaline fish that typically reside in open waters of the estuary (Moyle 2002). They are mostly found in the low salinity zone (2-7 psu), and have been collected from estuarine waters up to 14 ppt (Moyle 2002). The species generally lives about one year, although a small proportion of the population may live to spawn in its second year (Moyle 2002, Bennett 2005).

Delta smelt move into tidal freshwater habitats to spawn in late winter through spring. The upstream migration of delta smelt seems to be triggered or cued in part by increased in flow and turbidity associated with winter storm events (Grimaldo et al. 2009), but can also occur after very high flood flows have receded.

Spawning has been reported to occur primarily from late February through June (Moyle 2002, Bennett 2005), with a peak in April and May. Although delta smelt spawning has never been observed in the wild, it is believed that they spawn primarily in sloughs and shallow edge areas, utilizing bottom and near shore features throughout the Delta (USFWS 2008). Delta smelt spawning occurs when water temperatures range between 12ºC and 18ºC. Bennett (2005) reported that delta smelt spawning may occur at water temperatures up to 22^{o}C, although hatching success of the larvae is very low at these temperatures. Most adult delta smelt die after spawning (Moyle 2002), although some fraction of the population may hold over as two-year-old fish and spawn in the following year (USFWS 2008).

Delta smelt spawning distribution varies from year to year. In lieu of direct observation of spawning in the wild, the presence of newly hatched delta smelt juveniles in survey data (20-mm Survey results) has been used to infer major spawning regions. Over the years, delta smelt larvae (~5mm standard length [SL]) sampling has suggested that spawning has occurred widely in the Delta, including Cache Slough, the Sacramento Deep Water Ship Channel, the lower Sacramento River, Georgiana, Prospect, Beaver, Hog, and Sycamore sloughs, and in the San Joaquin River adjacent to Bradford Island and Fisherman's Cut (USFWS 2008). In recent years the densest concentrations of both spawners and juveniles within the Delta have been observed in the Cache Slough/Sacramento Deep Water Ship Channel complex in the North Delta (USFWS 2008). In

wet years, spawning has occurred west of the Delta in the Napa River, Suisun Bay, and Suisun Marsh (Sweetnam 1999; Wang 1991; Hobbs et al. 2007).

Delta smelt eggs are demersal and adhere to the substrate or plants over which they are spawned. They hatch after 9 to 14 days. Fish absorb their yolk sac and develop jaws over the next 4 to 5 days, then begin to feed on small planktonic organisms. Once this stage of their life begins, they drift with the predominant currents, perhaps exercising some control through vertical migrations in the water column (Bennett 2005). They become post-larvae about a month later, and juveniles about one month after that (Bennett 2005).

Delta smelt occur in schools and feed on zooplankton throughout their lives, mainly copepods, cladocerans, amphipods and some larval fish (Moyle et al. 1992a, Bennett 2005). Primary productivity and the resulting zooplankton biomass are important factors determining growth and survival in the summer and fall (Kimmerer 2008).

Delta smelt are most common in the low salinity zone of the northern estuary (Moyle et al. 1992, Sweetnam and Stevens 1993). While delta smelt can temporarily tolerate moderate salinities, most are found at salinities ranging from 0.2 to 5.0 ppt (Sweetnam and Stevens 1993; Feyrer et. al 2007, Nobriga et al. 2008). Geographic distribution delta smelt varies with that of the low salinity zone, which varies seasonally with freshwater outflow. The position of X2 (an index of the position of the 2 ppt isohaline near the bottom as measured in kilometers from the Golden Gate) defines the position of low salinity habitat in the estuary. The longitudinal position of X2 during spring and early summer varies as a function of freshwater inflow to the estuary and has been correlated with abundance or survival indices of numerous estuarine species (Jassby et al. 1995); including delta smelt (Kimmerer 2002).

Habitat for delta smelt is typically open water, largely away from shorelines and vegetated inshore areas except perhaps during spawning. This includes geographic features of Suisun Bay and the many large channels in the Delta. Delta smelt habitat is water with suitable values of salinity, turbidity, and temperature with low levels of contaminants and high prey production to support growth. Recent evidence suggests low salinity and relatively turbid water quality characteristics are important components of delta smelt habitat (Feyrer et al. 2007, and Nobriga et al. 2008).

Several Delta-wide habitat quality factors have shown changes over the 36-year record of concurrent mid-water trawl and water quality sampling. These changes have indicated a long-term decline in fall habitat quality for delta smelt (Feyrer et al. 2007), defined as a lowered probability of occurrence in samples based on changes in specific conductance and Secchi depth. There has been an increase in fall salinity that has positioned the X2 location farther upstream. There also has been a long-term decrease in the water turbidity in the Delta. Potential factors in the decreased turbidity may include a decrease in suspended sediment supply or biological filtering by submerged aquatic plants.

The large volumes of water withdrawn from the Delta result in inadvertent fish entrainment at the SWP and CVP export facilities. The entrainment effect of the export facilities is of particular concern in dry years when the distribution of young striped bass, delta smelt and longfin smelt shift upstream, closer to the diversions (Stevens et al. 1985; Sommer et al. 1997). Salvage data

collected at the SWP export facilities have tallied approximately 110 million fish over a 15-year period (Brown et al. 1996). However, the magnitude of this number grossly underestimates the actual number of fish entrained since it only includes fish that are salvaged, which does not include losses at the CVP or account for pre-screen mortality either in Clifton Court or in channels leading to the facilities. Larvae less than 20-mm long are not efficiently collected by the fish screens, and fish larger than 20-mm are lost because other inefficiencies in the louver system do not guide them into the salvage tank.

Evidence that entrainment played a role in the POD is the substantial increases in winter CVP and SWP salvage that occurred contemporaneously with declines in delta smelt and other POD species (Grimaldo et al. 2009). Increased winter entrainment of delta smelt represents a loss of pre-spawning adults and their potential progeny (Sommer et al. 2007). Other factors that may have contributed to the increase in winter entrainment include the reduction in the proportion of inflow to the Delta from the San Joaquin River and an increase in the duration of the operation of barriers placed into south Delta channels during some months. Collectively these changes may have contributed to a shift in Delta hydrodynamics that increased entrainment. These observations lead to a hypothesis that hydrodynamic change could be indexed by using net flows through Old and Middle rivers. An initial analysis revealed that there was a significant inverse relationship between net OMR flow and winter salvage of delta smelt at the SWP and CVP export facilities (Smith, unpublished). The general pattern is that POD species salvage is low when OMR flows are positive.

Predator-prey dynamics in the Delta are poorly understood, but are receiving increased scrutiny by IEP as part of the POD investigations. Delta smelt have been occasional prey items found in the stomachs of striped bass and catfish along with small striped bass and threadfin shad (Turner and Kelley 1966). Bennett and Moyle (1996) proposed that inland silversides may be impacting delta smelt through predation on delta smelt eggs and larva and competition for copepod prey. Since the early 1980s, there have been increases in other potential larval fish predators such as coded wire tagged Chinook salmon (Brandes and McLain 2001) and centrarchid fishes (Nobriga and Chotkowski 2000). Adult striped bass abundance increased in the latter 1990s so high striped bass predation pressure on smaller pelagic fishes in recent years is probable. Largemouth bass abundance has increased in the Delta over the past few decades (Brown and Michniuk 2007). The expansion of largemouth bass and other centrarchids in the Delta is associated with the habitat expansion of beds of Brazilian waterweed. Reductions in turbidity in the Delta may also work to increase predation on delta smelt.

The USFWS listed the delta smelt as threatened effective April 5, 1993 (USFWS 1993). Critical habitat for delta smelt as defined by the USFWS (1994) encompasses Suisun Bay and the entire Delta. The PCE's for delta smelt critical habitat include spawning habitat, larval and juvenile transport, rearing habitat, and adult migration. Because of the ongoing decline in delta smelt abundance, the species has been proposed for endangered status; the California Fish and Game Commission determined the species should be listed as endangered under CESA on March 4, 2009.

Longfin Smelt

The longfin smelt is a euryhaline species found in scattered bays and estuaries from California to Alaska (Moyle 2002). San Francisco Estuary harbors the largest and southern-most self-

sustaining population. Longfin smelt utilize freshwater, brackish, and marine habitats over their two-year life-cycle. This population is anadromous; adults migrate upstream from San Francisco Bay and sometimes from the ocean to spawn in the western Delta's freshwaters (Rosenfield and Baxter 2007). Longfin smelt generally occur in Suisun, San Pablo, and San Francisco bays, as well as in the Gulf of the Farallones, outside San Francisco Bay. Longfin smelt spawn in the Delta in freshwater when they are two-years old. Most spawning takes place from February through April. Larval longfin smelt move downstream with the tides until they reach favorable rearing habitat near X2 and later move downstream into Suisun and San Pablo bays.

Historically, adult longfin smelt tend to aggregate in Suisun Bay in late fall and spawn in an area bounded between the Sacramento River downstream of Rio Vista, and from Medford Island on the San Joaquin River to just downstream of the confluence of the Sacramento and San Joaquin rivers in the western Delta. In dry years or when export pumping is high, longfin smelt are drawn farther into the Delta and collected in salvage (Grimaldo 2007). 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. Young larvae are distributed in freshwater in close proximity to the low salinity zone (Baxter 1999, Dege and Brown 2004). Overall, their distribution is located west of the center for distribution of delta smelt and is consistently downstream of X2.

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 mysid shrimps when available (Hobbs et al. 2006). Adults and juveniles are 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.

Habitat for longfin smelt is typically open water, largely away from shorelines and vegetated inshore areas except perhaps during spawning. This includes geographic features of Suisun Bay and the many large channels in the Delta. Longfin smelt habitat is water with suitable values of salinity, turbidity and temperature with low levels of contaminants and high prey production to support growth. Salvage events are often associated with low flow years when longfin smelt move further upstream into the Delta presumably in search of freshwater habitat conditions for spawning.

Predation risk is similar to delta smelt, with the exception that longfin smelt spend less time in the Delta. They also are exposed to predation from striped bass and other predators in San Francisco Bay and in the Gulf of the Farallones.

Longfin smelt is not currently listed under the federal ESA. The California Fish and Game Commission listed longfin smelt as a state-threatened species under CESA on June 24, 2009. CESA does not provide for the designation of critical habitat for sensitive species.

North American Green Sturgeon

Green sturgeon are among the largest freshwater fishes, with a maximum length of about 2.3 meters and body weight of 159 kilograms (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 (NMFS 2002).

Green sturgeon have always been uncommon relative to white sturgeon within the Sacramento-San Joaquin River Delta (Moyle 2002), and reliable population estimates do not exist (Adams et al. 2007, Beamesderfer et al. 2007, NMFS 2009). Green sturgeon juveniles occur throughout the Delta and San Francisco Bay. They occur mostly in small numbers, but sometimes they occur in groups as large as one hundred fish.

Spawning occurs upstream of the Delta 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 2009). Juveniles, subadults, and adults are widely distributed in the Delta and estuary areas, including San Pablo Bay (Beamesderfer et al. 2007). The Delta is an important year-round nursery for juveniles for about one to four years before they disperse into salt water (Nakamoto et al. 1995, NMFS 2009). Juvenile green sturgeon have been salvaged at the SWP and CVP fish facilities in the south Delta and captured in trawling studies by the DFG during all months of the year (Adams et al. 2007, DFG 2002). The majority of these fish were 28-38 centimeters fork length (Adams et al. 2007). Juveniles smaller than 200 millimeters do not comprise a significant proportion of Delta captures, suggesting that younger green sturgeon likely hold in the main stem Sacramento River, such as has been observed in the Klamath River (Kynard et al. 2005).

It is believed that green sturgeon spend a large proportion of life in the ocean (Moyle et al. 1992). Adults pass through 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 2008). Subadults and non-breeding adults can inhabit the Delta and bays during summer months, most likely for feeding and growth (Kelly et al. 2007, Moser and Lindley 2007). Movement studies of tagged subadult and adult sturgeon in San Pablo Bay document nondirectional movements on the bottom when presumably foraging, and directional continuous swimming in the upper 20 percent of the water column (Kelly et al. 2007)

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

On September 8, 2008, NMFS proposed critical habitat for the Southern Distinct Population Segment (DPS) (NMFS 2008). 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 2008).

Chinook Salmon

Two listed runs of Chinook salmon occur seasonally in the Sacramento River – the federally endangered Sacramento River winter-run Chinook salmon and the federally threatened Central Valley spring-run Chinook salmon. Some juveniles of these runs may pass through the area where the Proposed Action would be implemented. The adult and juvenile life stages of Chinook salmon (fry, parr, and smolt) occur in the vicinity of the Proposed Action in the Delta. The differences between these runs are principally in the timing of adult and juvenile migrations into and out of the Central Valley rivers and through the Delta, their use of the Delta as rearing habitat, and the timing and location of spawning (which occurs well upstream of the Delta). For the purposes of this EA, life history information about juvenile rearing patterns in the Delta is considered generally applicable to all runs.

Sacramento River Winter-Run Chinook Salmon

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

Winter-run Chinook salmon tend to have characteristics that are intermediate between stream and ocean-type fish; they enter freshwater as green (sexually immature) fish during the winter, migrate far upriver, and delay spawning for months. This is typical for a stream-type life history, but juvenile winter-run Chinook salmon migrate to sea after only four to seven months in fresh water (ocean-type life history), leading to a conclusion that it is difficult to classify this run as either an ocean- or stream-type life history (Healey in Groot and Margolis 1991, WCCSBRT 1997).

Adults migrate through San Francisco Bay and the Delta from November through June. Spawning occurs in the upper Sacramento River below Keswick dam mainly in May and June. Fry emerge mid-June through mid-October.

Winter-run juveniles begin migrating to sea from November to December, and peak juvenile abundance generally occurs in the Delta from January to April. Distinct emigration pulses of outmigrants appear to coincide with high Sacramento River flows and turbidity associated with precipitation events. Upon arrival in the Delta, winter-run Chinook salmon tend to rear in the more upstream freshwater portions of the Delta for about two months. Winter-run Chinook salmon mature at sea between two and four years of age (NMFS 1997).

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 in Groot and Margolis 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). Floodplain 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). Juvenile Chinook salmon exhibit a "diel" migration pattern, whereby they orient themselves to nearshore cover and structure during the day, but move into more open waters at night (Kjelson et al. 1982).

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

The 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 and Delta and San Francisco Bay and grows to maturity in offshore ocean waters.

Adult spring-run Chinook salmon enter freshwater as sexually immature fish, migrate far upriver, and delay spawning for months (stream-type life history) (WCCSBRT 1997, Healey in Groot and Margolis 1991). Adult upstream 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 from 3 to 15 months in freshwater habitats prior to emigrating to the ocean; most emigrate as yearlings (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 and Titus 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). Major periods of 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-run Chinook salmon occur in the Sacramento River and its tributaries, the San Joaquin River and five of its east-side tributaries, including the Merced, Tuolumne, Stanislaus, Mokelumne, and Consumnes rivers. Late fall-run Chinook salmon occur only in the Sacramento River and its tributaries (Moyle 2002), where the population appears to be stable despite its low abundance (NMFS 2008). 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 (WCCSBRT 1997).

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 (Groot and Margolis 1991, Moyle 2002). Late fall-run are mostly stream-type Chinook that enter freshwater as sexually immature adults, migrate to main stem 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. The majority of fall-run juveniles emigrate through or rear in the Delta from February through June during the first few months following emergence, although some may remain in freshwater and migrate as yearlings.

Late fall-run juveniles rear for 7 to 13 months in main river channels, feeding on invertebrates and growing rapidly. Following their long freshwater residence time, late fall-run juveniles emigrate from the Sacramento River through the Delta during November through March (Moyle 2002).

The fall/late fall-run of Central Valley Chinook salmon is 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*). They are similar to salmon in that they are anadromous, but unlike other species of salmon, steelhead have a more flexible life history – spending from less than one to up to three years rearing in freshwater before migrating to the ocean. Unlike salmon, steelhead adults do not necessarily die after spawning. Populations in the Central Valley are found in the Sacramento River and its tributaries, as well as the Mokelumne and Consumnes rivers. Steelhead have also been documented in the Calaveras and Stanislaus Rivers (Cramer 1991), which are tributaries to the San Joaquin River.

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 for spawning and rearing but now are confined to lower stream reaches below dams.

Adults spawn in the tributaries from December through April (McEwan and Jackson 1996, WCCSBRT 1997). After spawning, the surviving adults (called kelts) move downstream through the Delta and back toward the ocean from January through May. Juvenile 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 entering the ocean.

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 provides rearing habitat for juvenile steelhead (McEwan and Jackson 1996). Juvenile steelhead rear and forage in the 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 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 proposed Old River and Connection Slough sites are designated critical habitat.

3.4.1.11 Other Species of Interest

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.

Splittail spawn primarily in flooded terrestrial habitats. Adults are salvaged most frequently at the SWP and CVP fish facilities from January through April (Moyle 2002). Spawning can occur from February through May when temperatures range between 14 and 19°C (Moyle 2002). Hatched larvae remain in shallow habitats until floodwaters recede, then migrate into adjacent channels and begin moving downstream.

Splittail are opportunistic benthic foragers that may feed on opossum shrimp, earthworms, clams, insect larvae, and other invertebrates. They are preyed upon by striped bass and other predatory fish in the estuary.

Splittail were federally listed as a threatened species, but the listing was later remanded. Splittail are relatively long-lived (7 years or more) boom or bust spawners – producing large number of young fish in wet years with extensive floodplain inundation, but with much lower rate of reproduction in dry years.

Striped Bass

Striped bass is an introduced anadromous fish that supports a substantial recreational fishery throughout the San Francisco-Bay Delta region and inland rivers. Young striped bass can be found year round in Central Valley rivers, the Delta, San Francisco Bay, and in the Pacific ocean. Adults are typically most abundant in the ocean or downstream bays during summer and then move into the delta during fall and winter before spawning primarily in the Sacramento River during the spring; limited spawning also occurs in the delta within the San Joaquin River.

Striped bass begin spawning in the spring when water temperatures reach 15°C. Most spawning occurs from April to June. Spawning occurs in areas of moderate to swift currents. The current suspends the eggs and larvae while they develop. Important spawning areas occur in the Delta on the San Joaquin River from the Antioch Bridge to Middle River, especially during years of low flow (Moyle 2002).

Striped bass populations have been in decline since the late 1970s. Declines have been attributed to many factors including reduced egg supply, altered habitat conditions, contaminants, water diversions, and food web effects.

Threadfin Shad

Threadfin shad is an introduced species and is found throughout California in open waters of reservoir, lakes, and large ponds as well as sluggish backwaters of rivers. They occupy warmer waters and do not tolerate sudden drops in temperature or prolonged periods of cold water. Spawning generally happens in April through August, peaking in June and July when water temperatures exceed 20°C. The embryos hatch in three to six days, and larvae immediately assume a planktonic existence. The larvae metamorphose into juveniles at about 2 centimeters total length. Juveniles form dense schools and in estuaries are most abundant in fresh water.

In the Delta, threadfin shad is a major item in the diet of striped bass and other piscivorous fishes. Abundance of threadfin shad in the Delta has fluctuated since monitoring began in 1967, but has dropped to persistent near-record lows since 2002.

American Shad

American shad is an introduced anadromous fish that supports a popular seasonal recreational fishery in the Sacramento River and major tributaries during its spring spawning migration. American shad occur in the Sacramento River, its major tributaries, such as the Lower American, Lower Yuba, and Lower Feather rivers and portions of the San Joaquin River and the Delta.

Adult American shad are abundant in the Delta in spring during the migration between April and June. Many shad spawn in the Sacramento River and tributaries upstream of the Delta. Flows and water temperature strongly influences the timing of spawning. Larval shad can be found along the rivers during spring and early summer as they move downstream. Juvenile American shad are found north of the Delta on the Sacramento River and to a lesser extent in the south Delta (Moyle 2002). They migrate downstream to reach the Delta, San Francisco Bay, and the ocean in fall. American shad spend several years in salt water before returning to spawn.

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 (larval lamprey) require sandy backwaters or stream edges in which to bury themselves, where water quality is continuously high and temperatures do not exceed 25°C.

As adults, river lamprey 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 water or fresh water.

3.4.2 Regulatory Setting

The following laws and regulations related to aquatic biological resources are applicable to the Proposed Action.

Federal Endangered Species Act

The ESA of 1973 and as amended in 1988 establishes a national program for the conservation of threatened and endangered species of fish, wildlife and plants and the preservation of the habitat critical to the survival of listed species. The purpose of the ESA is to conserve the ecosystems upon which the endangered and threatened species depend and to recover listed species. Under the ESA, species may be listed as either “endangered” or “threatened.” “Endangered” is defined as a species in danger of extinction throughout all or a significant portion of its range. “Threatened” is defined as a species likely to become endangered within the foreseeable future.

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 designated critical habitat.

Section 7(a) of the ESA requires federal agencies to ensure that the actions they authorize or fund, and carry out do not jeopardize species listed as threatened or endangered or their critical habitats. As defined in the act, the lead federal agency may request consultation with USFWS and/or NMFS (collectively referred to as "the Services") if the lead agency has reason to believe that a listed species is likely to be affected by a proposed action. The lead federal agency prepares a Biological Assessment (BA), which is reviewed by the Services. The responsible service or Services issues a BO regarding how the proposed action would affect listed species or critical habitat. If the Services determine that a proposed action would jeopardize the continued existence of a listed species, or interfere with its recovery, the Services must issue a BO offering RPAs about how the proposed action could be modified to avoid jeopardy.

Clean Water Act

Section 404 of the CWA 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.

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 (RWQCB), in this case the CVRWQCB, must issue a Water Quality Certification for discharges requiring Corps permits for fill and dredge discharges.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 U.S.C. 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 with 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 EFH. Effects on habitat managed under any relevant Fishery Management Plans must also be considered. For the Proposed Action, the EFH assessment is integrated into this 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 area affected by the Proposed Action does include EFH for migrating and rearing fall-run and intermittently for holding or rearing late fall-run Chinook salmon. It 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, is covered under the Groundfish Management Plan.

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 Natural Community Conservation Plan.

3.4.3 Environmental Consequences

3.4.3.1 No Action Alternative

Under the No Action alternative none of the potentially adverse effects would occur.

3.4.3.2 Proposed Action

The region of influence for aquatic biological resources is the area that would be affected directly or indirectly by the Proposed Action and is not merely the immediate area involved in the action. The Old River and Connection Slough sites would be directly affected by the Proposed Action during construction, including dredging of about 2.1 acres of bottom habitat in Old River and Connection Slough, installation of a sheet pile wall, placement of foundation and locking rock for the barge and installation of the boat ramps. Dredged material would be placed on Bacon Island and Roberts Island (if needed), but the use of these disposal sites would not

affect aquatic habitat because these Delta islands are below sea level and separated from the water courses by levees.

Operation of the gates would affect a large area in the Delta, including the in-channel sites where construction would take place, as well as an extensive area of the central and south Delta where changes would occur to channel flows (direction, magnitude, and/or duration) and water quality (primarily turbidity or salinity). The region of influence includes the channels of Old and Middle River, the San Joaquin River channel between the western edge of Big Break near the Antioch Bridge to Mossdale, the Sacramento River from Threemile Slough to the Delta Cross Channel, the Mokelumne River channels from the confluence with the Consumnes River to the San Joaquin River, Middle and Old rivers and the tidal sloughs west of Old River, Little Potato Slough, Georgiana Slough, and all interconnected riverine or tidal channels between these identified channels and, including Columbia Cut, Turner Cut, Railroad Cut, Woodward Canal, Victoria Canal, the Grantline Canal and Old River east of the Grantline Canal. The region of influence is entirely within designated critical habitat for delta smelt and Central Valley steelhead and entirely within proposed designated critical habitat for North American green sturgeon. Furthermore, the region of influence includes that portion of the Sacramento River between Threemile Slough and the Delta Cross Channel that is designated critical habitat for Sacramento Valley winter-run and Central Valley spring-run Chinook salmon (Figure 3.4-1).

Phytoplankton, Primary Productivity, and Zooplankton

Since the period of in-Delta water construction is short and the area affected by the construction of the Proposed Action is limited when compared to the aquatic habitats in the Delta, construction or removal of the gate facilities for the Proposed Action would not substantially affect the overall primary productivity of the Delta or the populations of phytoplankton or zooplankton. Likewise, the construction or removal phases are unlikely to substantially affect the distribution, habitat quality, or predation of these species.

The effect of operations of the Proposed Action on primary productivity and the distribution phytoplankton and zooplankton populations, their distribution or their habitats and other influences on life-stage development is dependent on changes in Delta hydrodynamics from gate operations and export modulation. The nature of effects on phytoplankton primary production rates or standing stock changes is unknown. However, chlorophyll-a data from 1996-2005 indicate that the region of the Delta most affected by the Proposed Action (Old River at Franks Tract and at Bacon Island) generally contributes less to the recent production of phytoplankton biomass compared to other portions of the Delta (Jassby 2008). The modeled decrease in turbidity from the operation of the Proposed Action during winter months is unlikely to affect primary production rates. However, in all operational months, the residence time of planktonic standing stocks is likely to be affected by operations of the Proposed Action.

Aquatic Vegetation

During operation of the Proposed Action, floating aquatic vegetation (FAV) and free-floating broken parts of SAV would collect in the low velocity areas around the gates. SAV may establish beds in shallower habitats along the sheet pile wall near the levee. The SAV and FAV may provide habitat for ambush predators (Grimaldo et al. 2004; Nobriga et al. 2005). The presence of these predators could increase risk of predation of fishes around the gates. Because

SAV and FAV can obstruct boat traffic or interfere with gate operations, nuisance mats of vegetation physically would be cleared as necessary.

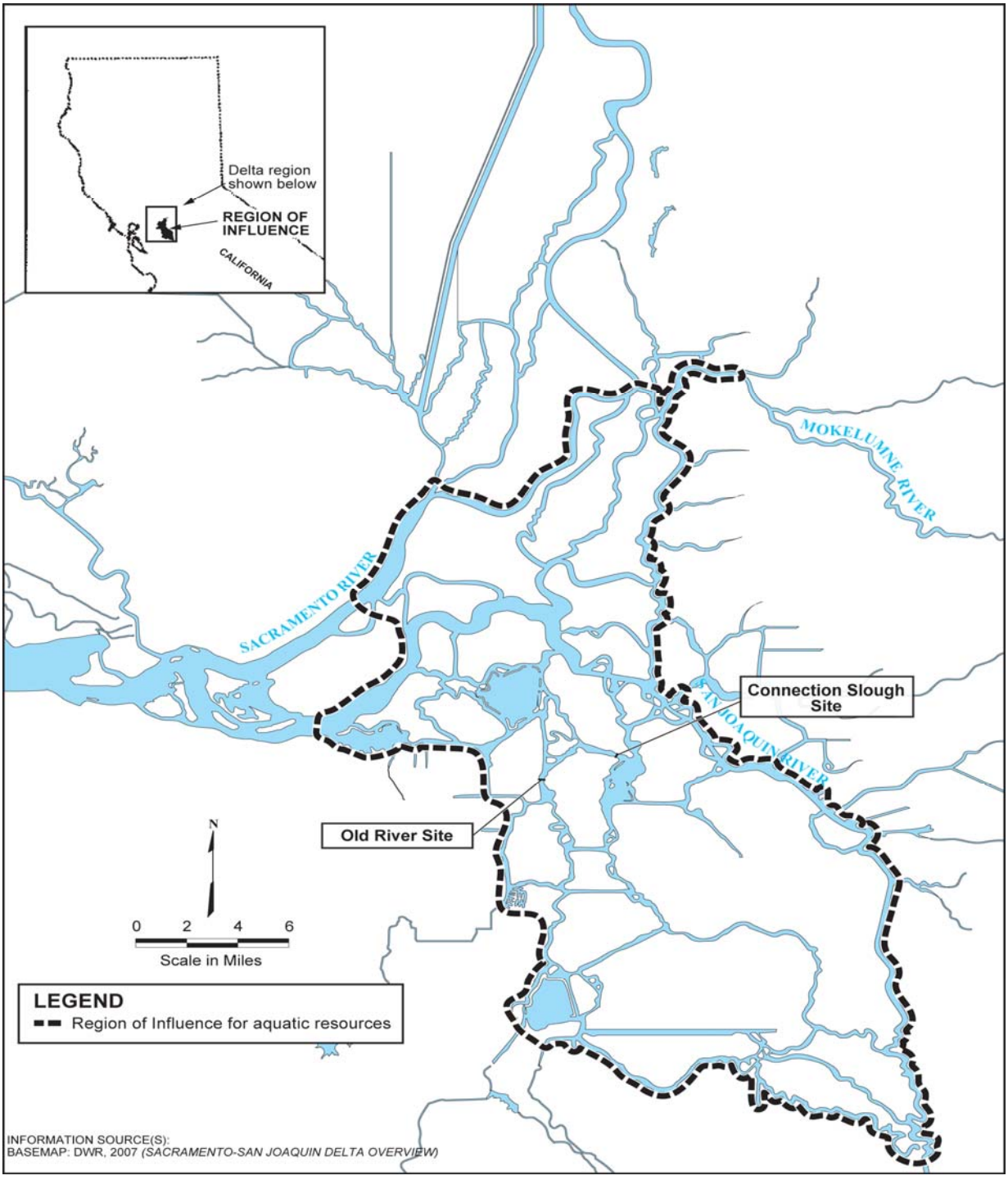


Figure 3.4-1 Region of Influence for Aquatic Resources

Fish

The effects of the proposed project were analyzed for fishes (including juvenile and adult lifestages) that are likely to be in the vicinity of construction impacts and the region of operational influence. The potential effects of the Proposed Action's construction and operations on habitat (hydrodynamics, water quality, physical structure), distribution (including fish movement), entrainment, predation, and food availability were considered.

Construction and demolition are planned for mid-summer through fall when many species would not be present (delta smelt, longfin smelt, and winter-, spring-, and fall and late fall-run Chinook salmon). Green sturgeon and juvenile steelhead have the potential occur at low densities. Other aquatic species, including largemouth bass, striped bass, sunfishes, catfishes, would be expected to occur in the Delta and could be found in the construction area during the construction period. In-water construction activities could result in direct injury or mortality, noise and disturbance, and resuspension of sediments near the construction site. The construction effects would be largely localized in time and space and would not affect fish distribution through the Delta, entrainment risk, or food web dynamics.

Operations would substantially modify hydrodynamic flow patterns in the interior Delta during the months of December through March and June, and to a lesser degree in the other months when the gates are left open. In general, the overall effects of altered hydrodynamics and water quality are expected to be beneficial for delta smelt and other pelagic species because the Proposed Action is thought to reduce entrainment risk from the SWP and CVP pumping facilities. Proposed facilities and operations could also result in changes to the aquatic ecosystem, including distribution of fish populations, fish movement patterns and migration routes, and change site-specific predation. The Proposed Action would change the amount and location of habitat conditions conducive to pre-spawning adult delta smelt and consequently would affect the distribution of spawning and rearing in some portions of the central and south Delta. Each of these impacts is discussed below by species, lifetage (delta smelt, longfin smelt, and salmonids only) or species groups for the sensitive species found in the area that would be affected by the Proposed Action.

Delta smelt Construction

Disturbance from construction and demolition activities would be limited to permissible work windows and therefore would not affect delta smelt.

Performance criteria would be used to comply with permit conditions as outlined in Section 2. Excessive turbidity caused by proposed construction would be attenuated by slowing or suspending dredging operations to bring water quality criteria into compliance in the local area of construction. Therefore, turbidity in excess of compliance levels 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 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 since they will be distributed downstream. 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

Operations of the Proposed Action would alter the structure of local habitat through modification of the channel and physical habitat over a larger spatial scale (e.g., altered hydrodynamics and water quality). Habitat effects would include a predicted change in delta smelt distribution in response to altered turbidity and salinity from balancing flows through gate operations (RMA 2009, Hydrodynamic, EC and Turbidity Simulations in Appendix A). The altered distribution is designed to reduce entrainment risk by preventing or minimizing smelt movement into the south Delta and hence close proximity to the pumping facilities (RMA 2009, Adult Delta Smelt Behavior Model in Appendix A). Overall, the Proposed Action is designed to have beneficial effects on delta smelt.

Water Quality. As described in more detail in Section 3.9, the Proposed Action is designed to alter flow patterns to manipulate salinity and turbidity. When closed, the gates would create temporary channel conditions similar to dead-end sloughs. Portions of channels adjacent to the Old River and Connection Slough gates would have reduced tidal flows and reduced mixing, which could result in temporarily slightly altered water quality, such as reduced dissolved oxygen concentrations and minor changes in salinity. The gates may temporarily trap floating debris and cause locally increased water clarity. Changes in flow patterns and water quality in these channel segments are likely to make delta smelt and other small fishes present in the channel segment more vulnerable to predation by piscivorous fishes such as striped bass and largemouth bass.

Proposed operations are also expected to increase water circulation in the channels downstream of the gates, which is predicted to lower turbidity and salinity in this area leading to the SWP and CVP. Decreases in turbidity are expected to minimize delta smelt occupation in these channels, which will effectively reduce their entrainment risk. Hydrodynamic and turbidity modeling (Appendix A) indicates that up to 6 or 7 miles of the Old River channel between the Clifton Court gates to near SR 4, including the Victoria Canal and some of Middle River may have reduced turbidity. Other south Delta channels such as Empire and Turner cuts and interconnecting channels may have small changes in habitat with suitable turbidity and salinity conditions for delta smelt.

Changes in the amount of habitat suitable for pre-spawning adult delta smelt were quantified using the hydrodynamic and turbidity model (Appendix A). The amount of habitat suitable for pre-spawning delta smelt was defined based on a salinity (represented as electrical conductivity [EC] of less than 1,000 micromhos per centimeter [umhos/cm]) and turbidity (greater than 15 NTU). The amount of this modeled delta smelt habitat was analyzed by examining weekly averages for the pre-spawning adult migration period of December 1 to March 31. The model domain had a maximum amount of total surface acres within the Delta of approximately 76,000 acres.

A comparison of the current total surface area of these habitat component and that occurring under the Proposed Action (based on 2003-2004 hydrology) are shown in Table 3.4-3. These simulations represent a single dry water year type and therefore do not necessarily represent all year types, and support the assumption that gate operations would have small overall effects on salinity and turbidity in dry years. Changes in available habitat resulting from the Proposed Action relative to current operations range from 0 to -3 percent. The largest percentage of change would occur when the amount of modeled habitat is relatively small. Detailed results are available in Appendix A. The amount of modeled delta smelt habitat over time range from 0 acres at the start of the period in December to about 72,000 acres following a storm event. Simulations show that turbidity would be reduced in key south Delta channel locations in close proximity to the export facilities and that the overall change in the amount of habitat conditions suitable for pre-spawning delta smelt would be relatively small across the entire Delta and strongly influenced by inflows. The modeling suggests that the Proposed Action would have a small effect on overall habitat conditions suitable for delta smelt, but would be effective at reducing habitat in key channels in the south Delta.

Table 3.4–3 Modeled Simulations of Weekly Averaged Pre-spawning Delta Smelt Habitat (Acres) Comparing Current Conditions and Proposed Operations

Week	Current Conditions (acres)	Proposed Action (acres)	Percent Change from Current Operations to Proposed Action
Dec 06, 2003	620	620	0%
Dec 13, 2003	7,221	7,221	0%
Dec 20, 2003	21,598	21,561	0%
Dec 27, 2003	36,713	35,558	-3%
Jan 03, 2004	51,664	51,151	-1%
Jan 10, 2004	63,613	63,087	-1%
Jan 17, 2004	63,031	62,527	-1%
Jan 24, 2004	57,294	56,920	-1%
Jan 31, 2004	56,217	55,943	0%
Feb 07, 2004	43,529	43,557	0%
Feb 14, 2004	50,711	50,803	0%
Feb 21, 2004	47,150	47,134	0%
Feb 28, 2004	65,379	65,243	0%
Mar 06, 2004	68,971	68,618	-1%
Mar 13, 2004	69,818	69,296	-1%
Mar 20, 2004	66,774	66,242	-1%
Mar 27, 2004	66,215	65,595	-1%

Spawning. Up to 2.1 acres of channel bottom in Old River and Connection Slough would be modified, however this will have little to no effect on delta smelt spawning. A small amount of

spawning habitat near littoral edges of the channel could be lost or modified (i.e., SAV colonization) at the location of the gates. In addition, if the Proposed Action performs as expected, delta smelt would lose access up to 3,500-4,500 acres of potential spawning habitat downstream of the gates. Gate operations would not directly affect substrate conditions necessary for spawning, only the potential use of the area by pre-spawning adults. This amount of potential spawning habitat was estimated by taking average channel widths over channel segments, and then summing the segments for the channel area approximating the length of channel with reduced turbidity. Habitat effects were presented under the Water Quality section above and are also relevant to this section.

Larval and Juvenile Rearing Habitat. When gates are operated for dispersive mixing, flows in Middle River become more strongly negative, while flows in Old River become positive (Larval/Juvenile Simulations, Appendix A). Based on particle tracking models, the dispersive mixing are predicted to improve advection of larval and juvenile smelt toward the lower San Joaquin River assuming they do not exhibit behavior contrary to neutral buoyancy. It is also possible that the dispersive mixing effect may increase the residence time of juvenile delta smelt in the central Delta and Franks Tract, which may make them more vulnerable to predation. Dispersive mixing may also improve habitat for delta smelt in the Sacramento-San Joaquin confluence area by increasing westward transport of phytoplankton and nutrients originating the upper San Joaquin River and central and southern Delta. The net circulation created is downstream on Old River and upstream on Middle River that increases the mixing between Franks Tract and the San Joaquin River (see Appendix A, Figure 82). This is likely to increase the entrainment of any delta smelt distributed in the San Joaquin River upstream of Old River. Dispersive mixing would occur during February through March and in June when the gates were under juvenile operations. Gates would remain open during April and May; therefore, effects on larval and juvenile delta smelt are limited to only increases to predation which may occur at the gate structures themselves.

The expected decrease in entrainment of larval and juvenile delta smelt during spring operations and improvement in westward transport of larval and juvenile smelt, and components related to primary productivity are expected to benefit larval and juvenile delta smelt rearing habitat.

Adult Entrainment. Adult delta smelt are thought to initiate spawning migrations coinciding with large precipitation events between December and March (Grimaldo et al. 2009). Recent analyses of salvage data indicate that delta smelt move in schools, perhaps following a turbidity gradient into upstream waters. The mechanisms underlying migration runs are unknown, but salvage of pre-spawning adult delta smelt frequently occurs coincident with the first large storm event of the season that occurs after the beginning of December. Modeling studies suggest that operations of the Proposed Action may reduce entrainment of pre-spawning delta smelt by balancing flows between Old and Middle rivers during these turbidity events, thereby reducing turbidity in the south Delta channel segments in close proximity to the export facilities. The modeling results assume that delta smelt will not occupy water with turbidity below 12 ntu and that the majority of entrained delta smelt get to the SWP and CVP facilities through Old River.

The gates would indirectly alter the migration routes of delta smelt, and the Proposed Action is modeled to deter adults from entering the south Delta. Because this project would be operated under the framework of the existing USFWS and NMFS RPAs USFWS 2008a; NMFS 2009),

expected entrainment of delta smelt is expected to decrease from recent levels even without the gates present. It is expected that adults not entrained would result in a net increase in the number of spawners in the Delta. It cannot be determined if increased number of spawners would result in an increase of progeny and an improved year-class strength.

Larval and Juvenile Entrainment. Larvae would be exposed to potentially reduced entrainment risk from reduced spawning in extreme south Delta channels. The dispersive mixing from the San Joaquin River and central and south Delta is expected to aid in transporting larval and juvenile smelt west toward their rearing habitat in the lower San Joaquin River and western Delta. Evaluation of particle entrainment (representing larval and juvenile smelt) at the SWP and CVP facilities from Delta regions for a wet and dry year show equal or lower entrainment with the Proposed Action compared to the operations under the OCAP BO for most regions south or west of the San Joaquin River (see Appendix A, Figures 59 and 68). Entrainment is higher from the San Joaquin River upstream of Bradford Island, the north Delta region and in Old and Middle rivers south of the gates locations under the Proposed Action when compared to current conditions. The north Delta region includes the North and South forks of the Mokelumne River. Overall, entrainment risk is expected to be lower under the Proposed Action and would be a net benefit to delta smelt.

Predation. It is possible that the physical structure of the gates and their habitat conditions they promote will affect the predation risk of delta smelt. The gate structures may attract predatory fish, and potentially increase predation risk on delta smelt and juvenile salmonids passing by the gate structure. Gate structure installation would also alter near-field channel hydraulics, changing the channel from mostly non-turbulent flow to periodically local flow conditions and placing higher velocity areas in close proximity to low velocity areas around the gate structures during portions of the tidal stage. This change would be most notable at the Old River site, where a larger volume of tidally driven water passes the gate structure during each tidal cycle. Accumulation of floating debris and establishment of SAV near the gates may increase predation during certain times or under certain conditions. The expansion of largemouth bass and other centrarchids in the Delta is associated with the habitat expansion of Brazilian waterweed. The gate structures and boat ramps could also provide feeding sites for fish eating birds, and lighting could provide increased opportunities for night feeding birds. If fish predator populations became established, attempts would be made to reduce populations through removal either using selective gill nets or angling. Bird predators would be discouraged by placing netting over roosting areas or through the use of other exclusion devices. The effect of the predators on delta smelt and other species would be evaluated as defined in the Science Investigations Program and Monitoring Plan (Appendix B).

Food Availability: Operation of the Proposed Action could potentially affect food availability, and altered hydrodynamics could affect phytoplankton and zooplankton, although the trend and magnitude of potential effects are uncertain. 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.

North American Green Sturgeon

Adult and juvenile sturgeon forage year-round throughout the Delta.

Construction

Green sturgeon are found throughout the Delta during the construction period and are likely to occur at the Old River and Connection Slough sites. There would be no effect to spawning or larval development, which occurs well upstream in the Sacramento River watershed from March through July, or juvenile development, which occurs throughout the Delta.

Construction would create localized disturbance and increased turbidity during dredging and installation of rock for the barge foundation and the locking rock. Noise would be generated by dredging, rock placement, equipment striking rock, or pile driving. Any noise generated would be transient, occurring during the daytime over a five-week period. The hearing sensitivity of green sturgeon is unknown. The noise effects of pile driving have been assessed by NMFS and others (NMFS 2006, Popper et al. 2006). Vibratory hammers are generally much quieter than impact hammers (ICF Jones & Stokes and Illingworth & Rodkin, Inc. 2009). Noise from pile driving would be reduced by using vibratory hammers when possible (sheet pile installation) and by installing an air bubble curtain when using impact hammers (king pile installation). Air bubble curtain systems have been used at bridge projects to attenuate underwater sound pressures from pile driving (ICF Jones & Stokes and Illingworth & Rodkin, Inc. 2009, Reyff 2009). Underwater noise associated with dredging, rock placement, surface machinery, and topside activities on the barge decks would be less than that resulting from pile driving because the other equipment that would be used generates less noise than impact hammers. Construction activities would not exceed NMFS's 2008 interim thresholds for underwater sound pressure levels of 206 dB peak and 187 dB accumulated sound. The effects of noise would be transient and localized, and would not result in direct injury or harm to nearby sturgeon. Anticipated responses of any fish within the work area would more likely be behavioral, such as avoidance or a startle response, although data are lacking on behavioral responses to pile driving (Hastings and Popper 2005). Sturgeon can be attracted to underwater disturbance of the substrate, probably as a benthic feeding strategy, and this would place sturgeon at risk for injury or death. Limited observations of green sturgeon occurrence in the Delta makes an assessment of this potential effect difficult, but based on the amount of habitat affected and the duration of activity, the effect would probably be minor.

Any adverse water quality conditions created through excavation of the channel bed or surround levee would be localized to the installation sites. In the event that water quality effects are seen downstream of installation sites, performance criteria would be used to comply with permit conditions, ensuring that impacts associated with turbidity and re-suspension of channel sediments would be short-term and minor. Activities would temporarily ceased or be reduced.

Operations

The Proposed Action would result in changes to water quality, potential predation, and access to feeding areas, rearing habitat, and juvenile and adult movement patterns, as discussed below.

The gates would be left in an open position from July through November. Green sturgeon would be able to pass through the gate areas during this period; therefore the gates would presumably have no effect on green sturgeon during this time frame.

Spawning. Green sturgeon spawning occurs well upstream of the Delta, so the proposed structures and operations would have no effect on spawning activities.

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 2008). The Proposed Action would not substantially modify water quality or remove a substantial amount of soft-bottom habitat from the Delta. Direct impacts would occur to about 2.1 acres of channel bottom compared to about 3,500 to 4,500 acres (0.04 to 0.06 percent) of channel bottom habitat in Old and Middle rivers between the Grantline Canal and the San Joaquin River, including Connection Slough, and the interconnecting channels between Old and Middle rivers and therefore would have a minor effect on sturgeon rearing habitat.

Adult and Juvenile Movement and Entrainment. Operation of the gates would tend to reduce entrainment into the south Delta from the Franks Tract area during the dispersive mixing operations by altering flows from negative to positive in the Old River channel. Net channel flow in the Middle River channel would become more negative and as a consequence reverse flows would increase in Columbia and Turner cuts. Adult green sturgeon in the Franks Tract area that are 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. Proposed 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.

Juveniles and subadult green sturgeon are in the Delta year round. Adults and subadults from the ocean may also enter the Delta and bay 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 2008). Proposed 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. The deck of the Old River gate would be close to the bed elevation of the channel and would not present a physical structure to overcome for passage. The gate structure at Connection Slough would be about 13 feet above the bed of the channel. The lock rock would be installed along either side of the barge with 1:5 slope transitioning from the channel bed to the top of the barge deck. This would effectively serve as a rock ramp to facilitate fish movement from the bed of the channel up to the deck of the barge so sturgeon can continue their movement in the channel when the gates are open.

Predation. Proposed operations would provide potential opportunities for predators. However, the predation risk for green sturgeon is not expected to be increased much because green sturgeon in this region of the Delta are a larger size (juveniles 200-500 mm) compared to Delta smelt or juvenile salmonids and have protective scutes (NMFS 2009). The predatory fish of most concern for sturgeon in the Delta include striped bass, largemouth bass, and channel catfish. Largemouth bass are resident fish, traveling locally within the channel. Striped bass are migratory and can move into and out of areas for feeding. Largemouth bass infrequently reach a size that could successfully prey on juvenile sturgeon. Gate operations would frequently change local hydrodynamics and would discourage the establishment of largemouth bass near the gates. Striped bass could use the changing hydrodynamics as feeding sites, but it would take a very

large striped bass to consume a 10 to 12-inch sturgeon. Channel catfish can reach large sizes in the Delta and are bottom-oriented fish, similar to sturgeon. The Proposed Action is not expected to greatly increase predation opportunities for channel catfish although the gates structures themselves may attract some catfish. Overall, fish predation would have a minor to no effect on green sturgeon in the Delta. Bird predation is not likely to be an issue for green sturgeon due the large size of the prey and the fact that sturgeon are bottom-oriented and not available to larges birds that are surface feeders. Marine mammals, principally California sea lions, are known to prey on sturgeon, but predation is not considered a major factor in the decline of green sturgeon (Adams et al. 2002). A recent survey in the lower reaches of the Sacramento and San Joaquin Rivers observed five individual sea lions in this region of the Delta and documented predation on chinook salmon and striped bass (Dendy 2008). The low number of sea lion predators suggests marine mammal predation would have minor to no effect on green sturgeon in the Delta. If fish predator concentrations became a problem, selective removal methods would be employed including angling or the use of selective size gill nets.

Food Availability. Alteration or reduction of the benthic community could potentially change the foraging habitat for green sturgeon potentially occupying the area. Data are lacking regarding the occurrence of green sturgeon within the project sites. Juvenile green sturgeon are collected at the CVP and SWP fish facilities so, by inference, some of these fish must pass by the gate structures.

Chinook Salmon and Steelhead

Construction

Adult spring- and winter-run and juvenile fall-run Chinook salmon would not be present in the vicinity of the Proposed Action 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. Juvenile spring- or winter-run Chinook may be present near the end of the construction period later in November. Fall-run Chinook salmon are produced from both the Sacramento and San Joaquin river systems. Based upon migration routes, a substantially smaller proportion of Sacramento River-produced salmon juveniles would be exposed to the proposed construction activities compared to the proportion of the San Joaquin River produced salmon; however, run size on the San Joaquin River systems is much lower compared to the Sacramento River. Mokelumne River salmon would also be exposed to proposed construction activities as they pass through the Delta.

Steelhead are encountered in the Delta during most of the year, with adults moving upstream from November through June, with a peak in February to March. Juvenile outmigration from the Sacramento, Mokelumne, and San Joaquin rivers peaks from March through May, which has some overlap with their peak appearance in salvage at the pumps. The effects of operations on juvenile and adult steelhead vary depending on the river system of origin.

Construction impacts generally would be very minor. Juvenile salmon and steelhead inhabit the water column and are not oriented at or near bottom substrates that would be disturbed by construction. Any modification of the benthic community would have no effect on juvenile salmonid rearing habitat because the affected invertebrates in the substrate are not generally available to species living in the water column and the area affected is very small (only 0.04 to

0.06 percent of channel habitat along Old and Middle rivers from the San Joaquin River to Grantline Canal).

Noise from construction activities would have a minor effect on salmonids, similar to those described above for green sturgeon. Construction activities would not exceed NMFS's 2008 interim thresholds for underwater sound pressure levels of 206 dB peak and 187 dB accumulated sound. The effects of noise would be transient and localized, and would not result in direct injury or harm to nearby salmon. Anticipated responses of fish within the work area would likely be behavioral, such as avoidance or a startle response, although data are lacking on behavioral responses to pile driving (Hastings and Popper 2005).

Existing riparian function is degraded and very small in relation to the size of the channel in Old River or Connection Slough. Construction of the abutments would have a minor effect on shoreline habitat supporting juvenile salmonids in the Delta.

Operations

Juvenile winter-, spring-, and fall-run Chinook salmon and steelhead are likely to be present in the Delta during operations. Fall-run fry that outmigrate in February immediately after emergence in the upstream rivers would be in the Delta during the operations for adult pre-spawning delta smelt and for operations for juvenile smelt until the end of March. Late fall-run juveniles are not anticipated to be in the Delta after March. Most salmon smolts migrate through the Delta during April and May when the gates would be open. Steelhead juveniles outmigrate in March through May when the gates are operated to protect adult or juvenile delta smelt or open. Adult winter and spring run Chinook salmon primarily use the Sacramento River side of the Delta on their upstream migration in the winter and spring. Adult steelhead would be migrating upstream through the Delta during winter and spring and kelts would be moving downstream in late winter and spring.

The gates would be left in an open position from July through November. Juvenile salmon do not occur in the Delta after June so would not be affected by the open gate facilities. Adult fall-run Chinook may be migrating upstream during the early fall when the gates are open and would be able to pass these sites without delay. Some juvenile salmon may pass the gate sites in November, and effects would be similar to encountering open gates during April and May. Steelhead may occur in the Delta at any time; adults and juveniles would be able to pass through the gates during their open position, and the effects would be similar to those occurring when gates were open during April and May. Increased temperatures during the summer months may increase predation pressure on juvenile steelhead near structures that attract predators present in the Delta during this period.

Water Quality. Water quality impacts near the proposed facilities would be as described for delta smelt. Operations in the late spring and early summer could slightly modify water quality that serves as a cue to out-migrating Chinook salmon and steelhead, especially those emanating from the San Joaquin River tributaries and steams discharging directly into the Delta (e.g., Mokelumne River). Since operations would cease during the Vernalis Adaptive Management Plan (VAMP) period in 2010 and 2011 (generally April 15 to May 15) and then supplanted by NMFS (2009a) RPA actions (gates open for all of April and May 2012 to 2014). The Proposed Action would have a minor effect on water quality that serves as a cue to Chinook salmon

outmigration during these periods. During operations for juvenile delta smelt flow cues from the central Delta may be enhanced by dispersive mixing; however, salmon and steelhead entering the area from the east may experience increased reverse flows in Middle River. These fish could also be assisted in their outmigration by the increase in the positive flows in Old River during this period. Most juvenile salmon and steelhead would have left the Delta by June. Given the implementation of monitoring and adaptive management of the proposed facilities before and after the VAMP period, impacts to out-migrating Chinook salmon and steelhead smolts would be minor to moderate.

Predation. Predation impacts near the proposed facilities would be similar to those described for delta smelt. Predation may increase near or at the gates during the salmon and steelhead outmigration period. Gate structures may provide habitat attractive to predators. Operations would result in continuously changing conditions around the gate and would limit the establishment of predator habitat. However, fish predators are known to move in and out of Clifton Court Forebay gates to make use of resources when the gates are opened. A similar situation could develop at the gates structure. Predation may become an issue during certain times or under certain conditions. Predation by California sea lions has been suggested as potential factor in the decline of salmonids, but the ecosystem-level impact is poorly understood (NMFS 1997), especially in the Delta. The number of sea lions in the Delta is small (about five, estimated by Dendy 2008).

Monitoring for predators is part of the project description and predator populations would be controlled through selective methods if found to become a problem. The overall effect of the predators is expected to be limited in time and space, and given the implementation of the proposed program to monitor and control their numbers; the overall effect of the Proposed Action would be limited. If predator concentrations become a problem, selective removal methods would be employed by employing including angling or the use of selective size gill nets.

Spawning. Chinook salmon and steelhead spawning occurs outside of the Delta; therefore, the Proposed Action would not affect habitat supporting spawning.

Rearing Habitat. The principal rearing habitat for juvenile Chinook salmon and steelhead in the Delta is shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels and sloughs (McDonald 1960, Dunford 1975). The Old River and Connection Slough sites do not provide of this type of habitat since the sites are deeper open channels with steep-sided levees at each bank. Therefore, the Proposed Action would have only a minor effect on the availability of rearing Chinook salmon or steelhead habitat.

Juvenile Migration and Entrainment. Juvenile Chinook salmon and steelhead 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 and steelhead from the Central Valley (Sacramento, Mokelumne, and San Joaquin river watersheds) use portions of the central Delta and would encounter both positive and negative changes in hydrology from the operation of the Proposed Action in concert with the USFWS CVP/SWP Operations OMR flow restrictions. Under certain hydrologic conditions, the gates would be effective at reducing the entrainment of juvenile Chinook salmon and steelhead from the western delta toward the pumps while under

other hydrologic conditions operations of the gates provides little benefit or even increase entrainment risk. The peak of the outmigration period for juvenile Chinook salmon and steelhead occurs from March to May and includes the VAMP period (April 15 to May 15). Steelhead tend to move through the Delta for a longer period compared to salmon. The gates would be open during much this period (1 April to 30 May for VAMP and the rest of the pulse flow period under the NMFS OCAP RPA IV.2.1 to minimize the effects on juvenile Chinook salmon movement through this area of the Delta. Proposed operations under the larval-juvenile smelt protection operations that may begin as early as February through March and in June are timed with tidal cycles (closed on flood and open on ebb). This would not impede juvenile Chinook salmon that follow the similar tidal cues in their movements within the Delta and other estuarine habitats. Given the implementation of monitoring and adaptive management of the proposed facilities before and after the VAMP period, of the NMFS CVP/SWP Operations actions, impacts to out-migrating Chinook salmon and steelhead would be minor to moderate.

In order to assess how salmonid smolt survival from the Sacramento River system to Chipps Island might be influenced by the Proposed Action, Cramer Fish Sciences conducted a preliminary model-based assessment using the Delta Passage Model (DPM) from DSM2 results provided by RMA. The DPM simulates migration and mortality of juvenile Chinook salmon through the Delta and provides quantitative estimates of salmonid survival within the Delta. What follows is a summary statement of how DPM works and the science that supports this model (complete discussion included as Attachment 1 to Appendix A). The biological functionality of the DPM is based on results of acoustic tagging and coded wire tag studies that have been conducted in the Delta.

The DPM is based on a detailed accounting of migratory pathways and reach-specific mortality as smolts travel through Delta channel networks. Smolt movement and survival rely on three major functional relationships: 1) smolts arriving at distributary junctions enter downstream reaches in proportion to the flow diverted; 2) smolt movement occurs daily and is a function of reach-specific length and migration speed; and 3) reach-specific survival is calculated as a logarithmic function of flow. Direct loss of migrating smolts at the CVP and SWP pumps is modeled as an exponential function of Delta export flow based on Kimmerer (2008).

The DPM used daily tidally averaged flows to evaluate the effects of the Proposed Action. In the model, simulated smolts were injected into the Sacramento River upstream of all distributary channels (Sutter and Steamboat sloughs, Delta Cross Channel and Georgiana Slough) using a typical timing pattern based on actual emigration timing for winter-run Chinook salmon smolts. Monte Carlo simulations[2] of smolt passage during various scenarios both with and without the Proposed Action were conducted to allow for uncertainty estimates to be placed about predicted Delta survival values.

Result of salmon smolt survival within the Delta based on 2003-2004 hydrology ranged between 34 percent and 42 percent for all of the scenarios evaluated. Only small differences in survival occurred between any of the 2-Gates Project scenarios, and no substantive survival differences occurred between the “No Project” and “With Project” scenarios. These results provide a useful preliminary assessment of the Proposed Action’s likely population-level effects for juvenile

[2] Monte Carlo simulations rely on repeated, random sampling and probability to compute their results.

salmonids originating in the Sacramento River, with the qualifier that there was no attempt to evaluate direct, site-specific mortality that may be associated with the Proposed Action.

While the DPM results address the effects of the Proposed Action compared to existing conditions on the survival of juvenile winter-run salmon and Chinook salmon from the Sacramento River system, the results can be generally applied to other Chinook and steelhead runs from the Sacramento River, but not to runs from the Mokelumne, Calaveras, or San Joaquin rivers. Entrainment is likely to increase for fish emigrating the San Joaquin River and Mokelumne River because of the altered hydrodynamics. This included Sacramento River fish that enter the Mokelumne River though either the Delta Cross Channel or Georgiana Slough.

The peak of the outmigration period for fall, late fall, and spring-run juvenile Chinook salmon and steelhead occurs from March to May and includes the VAMP period (April 15 to May 15). Steelhead tend to move through the Delta for a longer period compared to salmon. The gates would be open during much this period (1 April to 30 May, which includes the 30-day VAMP conditions, and the rest of the pulse flow period under the NMFS (2009) RPA IV.2.1). During the April to May pulse flow period, the gates would remain open to minimize effects on salmon and steelhead smolts originating from the Mokelumne, Calaveras, and San Joaquin rivers. During gate operations in February or March for juvenile delta smelt, outmigration success could be affected since the Old River gate is closed on flood tides and open on ebb tides, and the Connection Slough gate is open only during slack tide.

In the Old River channel south of the gate location, gate closure under juvenile operations could reduce tidal excursions during flood tides, but continue to transport smolts out of Delta channels during the ebb tide cycle. Conversely, smolts may follow the flow only cue available during gate closures. Gate closure would increase the flood tide flows on Middle River and could result in an increase in flow cues toward the export facilities for salmon and steelhead originating in the Mokelumne-San Joaquin River or entering the Delta via Georgiana Slough.

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 Proposed Action would have limited to no negative effects on Sacramento River spring and winter run Chinook salmon. Likewise, because of the location of the Proposed Action and its ability to reduce localized entrainment from the SWP and CVP pumps, the Proposed Action would have limited to no negative effects on fall and late-fall Chinook salmon runs from the Sacramento River.

When operated, the gates would act as temporary barriers to movement through Old River and Connection Slough, thus limiting the movement of fall-run Chinook salmon and steelhead adults upstream to their spawning grounds in the San Joaquin River tributaries or the Mokelumne River. However, the fall-run Chinook salmon migration is mostly over by December when gate operations are expected to begin to protect pre-spawning adult delta smelt. Gate operations would occur during the upstream migration period for adult steelhead into the San Joaquin and Mokelumne River systems (peak of February through March). The run of steelhead in the San Joaquin River is unknown but small. Adults passing upstream via Old River would encounter the gate structure primarily during operations for pre-spawning adults (closed 0.5 to 2.5 hours per

tidal cycle) and for juvenile operations beginning from mid February to the end of March (Old River closed during flood tides, open on ebb tides, Connection Slough closed, except is opened on slack). This operation would reduce velocities in the Old River during flood tides, while providing passage during ebb tides. Adult steelhead moving toward the San Joaquin River may be delayed or confused by the flow regime, but not completely inhibited from moving past the gates. San Joaquin flow signatures would move past the Old River gate during ebb tides to attract fish upstream. The proposed facilities are off the direct route to the Mokelumne River. Implementation of mitigation monitoring and adaptive management of the proposed facilities before and after the VAMP/CVP/SWP Operations RPA period would result in minor to moderate effects to San Joaquin River steelhead and minor to no effects to Mokelumne River steelhead.

Predation. Predation impacts near the proposed facilities would be similar to those described for delta smelt. Predation may increase near or at the gates during the salmon and steelhead outmigration period. Gate structures may provide habitat attractive to predators. Operations would result in continuously changing conditions around the gate and would limit the establishment of predator habitat. However, fish predators are known to move in and out of Clifton Court Forebay gates to make use of resources when the gates are opened. A similar situation could develop at the gates structure, although hydrodynamic conditions would be markedly different than the large flow events that occur when operating the Forebay. Predation may become an issue during certain times or under certain conditions. Predation could result from birds roosting on the structure or by night feeding birds attracted by the structure lighting. Predation by California sea lions has been suggested as potential factor in the decline of salmonids, but the ecosystem-level impact is poorly understood (NMFS 1997), especially in the Delta. The number of sea lions in the Delta is small (about five, estimated by Dendy 2008). The low number of sea lion predators suggests marine mammal predation would have minor to no effect on salmon and steelhead as a result of the Proposed Action. If fish predator concentrations become a problem, selective removal methods would be employed, including angling or the use of selective size gill nets.

Food availability. Effects would be as described for delta smelt.

Longfin Smelt

Construction

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 their more western distribution, earlier spawning, and shorter exposure time would result in a reduced effect on longfin smelt compared to delta smelt.

Operations

Juvenile and adult longfin smelt could be present during operations. The effects on longfin smelt would be as described previously for delta smelt, although their more western distribution and earlier spawning and shorter exposure time would result in a reduced effect on longfin smelt compared to delta smelt.

Water Quality. Water quality impacts would be as described for delta smelt.

Spawning. 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. Thus, the Proposed Action would have a limited effect on longfin smelt 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), and this places them out of the region of influence of the Proposed Action. Juveniles migrate further downstream to Suisun Bay and low-salinity habitats for growth and rearing (Moyle 2002). Thus, the Proposed Action would have a limited effect on longfin smelt rearing habitat.

Adult Migration and Entrainment. Adult longfin smelt are at risk from entrainment at the SWP and CVP pumps during the winter when they move into freshwater for spawning. The majority of their spawning occurs west of Medford Island on the San Joaquin River as well as on the Sacramento River downstream from Rio Vista to the confluence of the Sacramento and San Joaquin rivers. Longfin smelt are sampled in this area in dry years or in years with high export rates. This implies that channel flows may be a primary influence on adult longfin smelt movement. Export rates are limited by OMR flows defined by the USFWS BO (2008a). The effects of gate operations to balance flows would further reduce the effect of negative flows on Old River. Since longfin smelt tend to be oriented to a more westerly distribution, overall effects of gate operations would tend to reduce entrainment risk. Overall the Proposed Action would have a limited to positive effect on longfin smelt.

Food availability – Longfin smelt are pelagic feeders, so effects would be as described for delta smelt.

Splittail

Splittail spawn in the Delta and tributaries in the Napa River and Petaluma rivers, sloughs, and inundated floodplains from February through May. Larvae stay in or near these shallow water habitats until they reach about an inch in size before beginning to disperse downstream. Juvenile splittail may occur in open water habitat in the Delta and even San Pablo Bay. They begin appearing in the Mossdale trawl in May and shortly thereafter in salvage at the fish facilities.

Construction

Adult and juvenile smelt may be present in the Old River and Connection Slough during the construction period. Impacts generally would be as described for salmon.

Operations

Juvenile and adult splittail could be present during operations.

Water Quality. Water quality impacts would be as described for salmon and steelhead.

Spawning. The Old River and Connection Slough sites contain limited to no spawning habitat that would be suitable for splittail; therefore, there would be no effect on spawning habitat. Gate operations would not impair the ability of splittail to move upstream to spawning sites.

Rearing Habitat. Rearing habitat impacts would be as described for salmon and steelhead. Adult splittail habitat may be altered somewhat from the installation of the gate structure, but similar to sturgeon, the amount of habitat affected is very minor.

Adult Migration and Entrainment. Splittail move out of the Delta beginning in January and February to upstream habitats or areas of inundated vegetation for spawning. During this time, the gates would be operated for either pre-spawning adult delta smelt or juveniles and could potentially impede or delay the upstream migration of splittail.

Predation. Predation impacts would be similar to those described above for delta smelt.

Food Availability. Effects would be as described for delta smelt.

River Lamprey

River lamprey have been captured in the upper portions of the Delta and in the tributaries, while newly hatched larvae (ammocoetes) have been collected in plankton nets in the Delta.

Construction and Operations

Life history and run timing are not well understood, but it appears that both adults and larvae pass through the Delta and do not use the Delta for spawning or rearing. Therefore, the effects of the Proposed Action would be none to minor.

Other Fishes and Aquatic Resources

Construction

Construction impacts would be similar for green sturgeon and steelhead for other resident species or migratory species that would be present during construction or demolition.

Operational Impacts

Operational impacts on other species would be variable depending on the life history of the species involved. Resident littoral species residing in the area of construction would be most affected either by being harmed, displaced, or exposed to construction-related effects from underwater construction activities, including disturbance, habitat modification, turbidity, or noise. The temporary disturbance may provide opportunities for increased predation during construction activities. Resident littoral species and open water species may use the site for feeding.

The Old River and Connection Slough provide corridors for the movement of aquatic species such as striped bass, threadfin shad and American shad. The Proposed Action would alter the flows in these channels, in Middle River, and other associated channels in the Delta resulting in temporary, localized changes in habitat conditions. When gates are closed, migration routes or movement corridors could be affected, but these would only be temporary on the order of hours.

Therefore, the Proposed Action would delay, but not prevent, movement of migratory or resident fish. Moreover, alternative routes are available to fish moving through the central and south Delta Water quality impacts would not substantially affect these aquatic species. Plankton and other weak-swimming aquatic organisms that occupy the central Delta during juvenile operations would be exposed to the dispersive mixing and transport to the western Delta. Overall, the Proposed Action would have little to no effect on other aquatic species found in the Delta.

3.5 Terrestrial Biological Resources

The terrestrial biological resources investigation for the Proposed Action is based on surveys conducted at the proposed sites on Bacon Island and Holland Tract and Mandeville Island. Due to a lack of access to a portion of Holland Tract west of the levee road, the resource assessment is based on a review of aerial photography and binocular-aided scans of site from the levee road. This assessment was used to characterize the habitat types present and to determine the impacts of the Proposed Action. For all proposed sites, a search for recent relevant environmental documents, including those for projects adjacent to or in the vicinity of the Proposed Action was performed. The following pertinent documents were reviewed:

- California Natural Diversity Database (CNDDB) list for the area affected by the Proposed Action (DFG 2008, CNDDB 2009).
- California Native Plant Society's (CNPS) plant list for the Brentwood, Jersey Island, Woodward Island, and Bouldin Island 7.5-minute quadrangles, via electronic inventory (CNPS September 2008, October 2009).
- USFWS endangered and threatened species list for the Brentwood, Jersey Island, Woodward Island, and Bouldin Island 7.5-minute quadrangles (USFWS 2008a, 2009).
- DFG Special Status Species List (DFG 2008).
- Draft Environmental Impact Report, Dutch Slough Tidal Marsh Restoration Project (DWR and California State Coastal Conservancy, November 2008).
- Action Specific Implementation Plan for the Contra Costa Canal Replacement Project (CCWD and Reclamation, March 2007).
- Preliminary Delineation of Waters of the United States for the Delta Wetlands Project (Jones & Stokes 2001) and correspondence with the Natural Resources Conservation Service (April 2, 2002), Jones & Stokes (April 19, 2002), and the Sacramento District of the Corps (May 20, 2002) concerning jurisdictional areas on Holland Tract, Bacon Island, Bouldin Island and Webb Tract.

Mosaic Associates conducted preliminary wetland delineations at the Old River and Connection Slough sites on Holland Tract, Bacon Island, and at Mandeville Island. Delineations were carried out on August 1 and 8, 2008; September 9, 23 and 29, 2008, and October 6, 2009. The preliminary delineation, "Delineation and Preliminary Jurisdictional Determination of Wetlands and Other Waters of the U.S. under Section 404 of the Clean Water Act for the Proposed Two-Gates Project Area, Contra Costa and San Joaquin Counties, California" (Mosaic Associates, October 7, 2009), is included in Appendix F.

An inventory of habitats present within the study areas defined for the Proposed Action and an assessment of the presence of habitats suitable for terrestrial special-status species were conducted by Mosaic Associates on August 1 and 8, 2008; September 9, 23 and 29, 2008, and October 6, 2009. Maps of habitats are depicted in Figures 3.5-1 and 3.5-2.

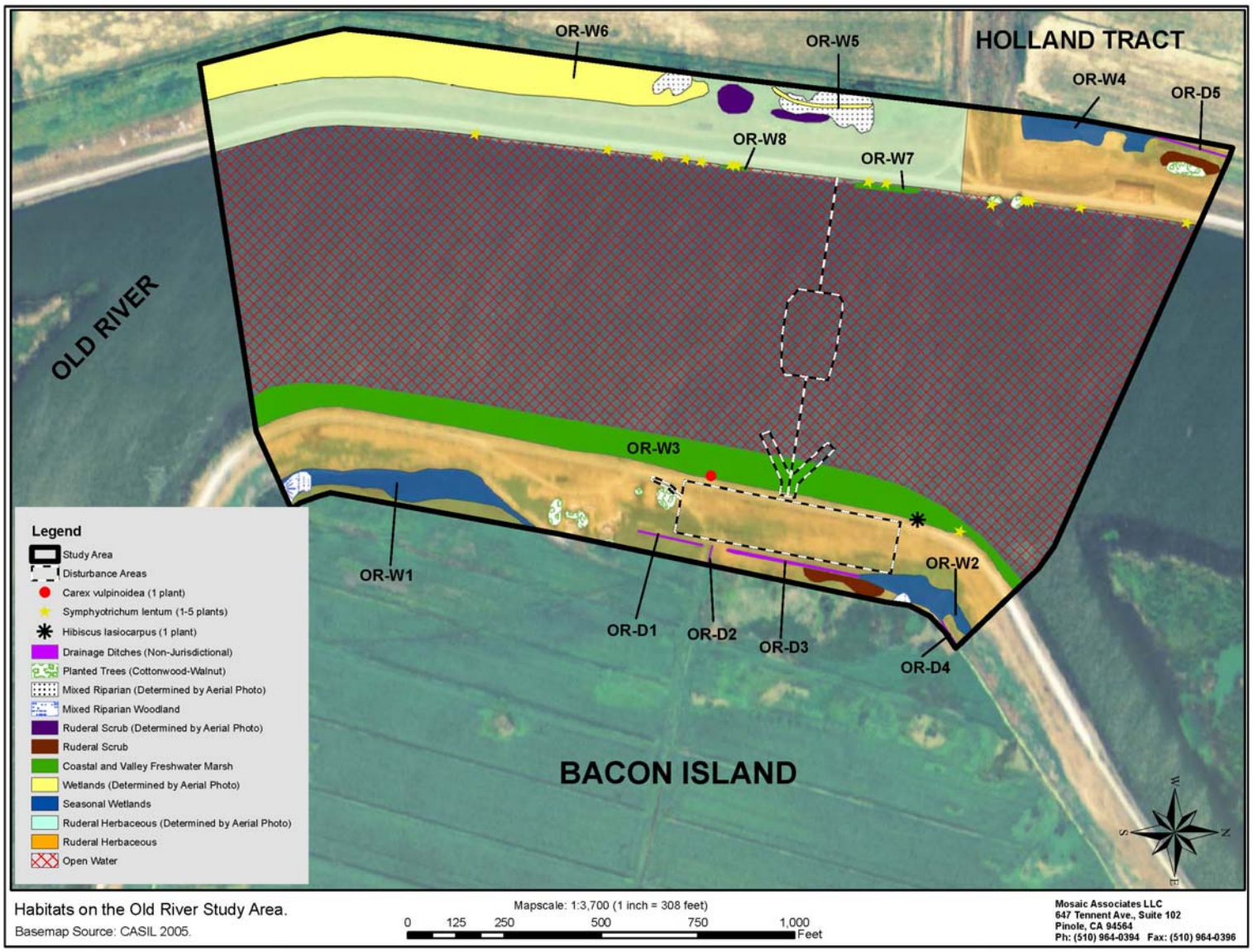


Figure 3.5-1 Habitats on the Old River Study Area

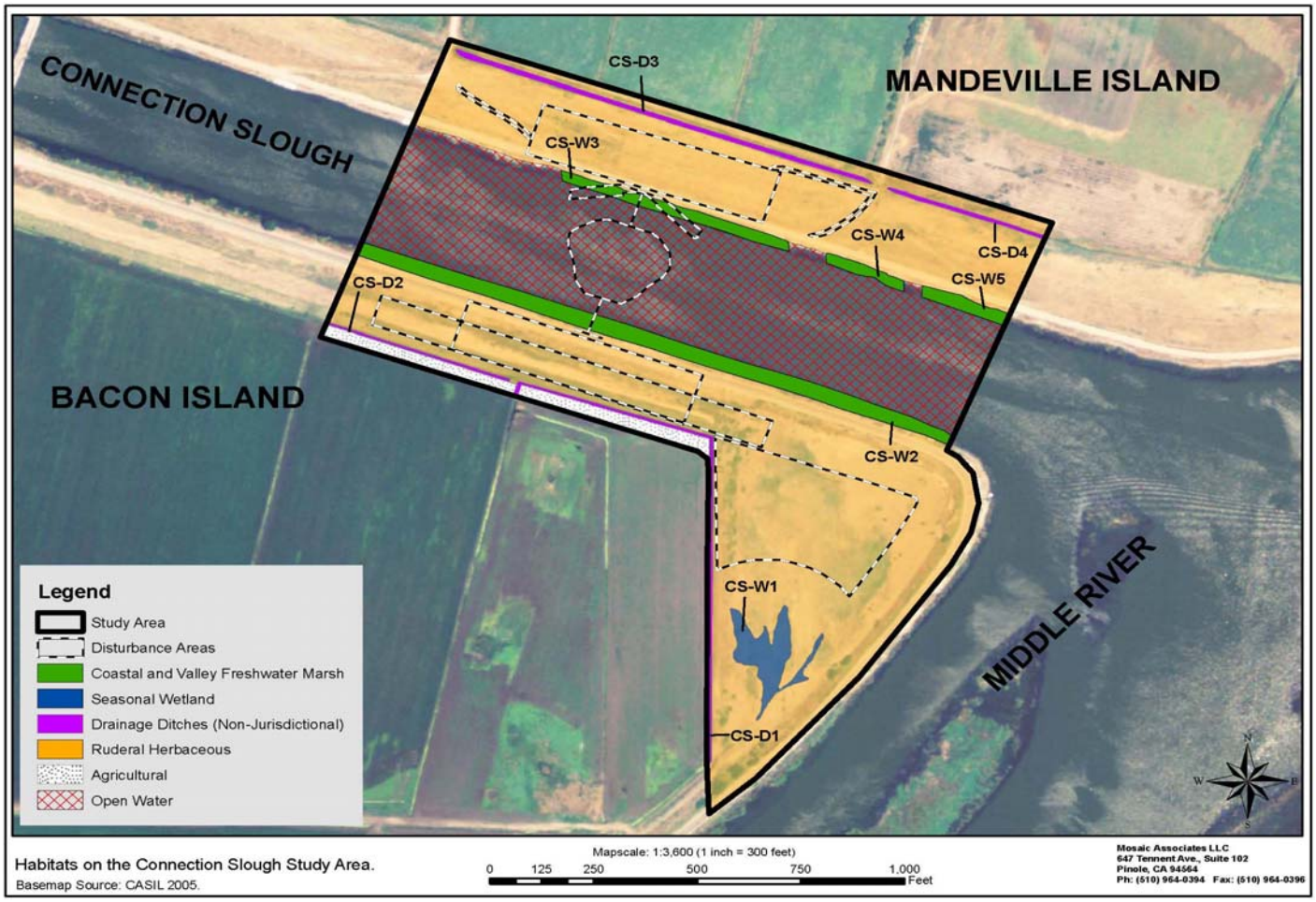


Figure 3.5-2 Habitats on the Connection Slough Study Area

Summer rare plant surveys for late-blooming species at the Old River and the Bacon Island portion of the Connection Slough sites were conducted on September 23 and 29, 2008. Two summer-blooming rare plants were detected – woolly rose mallow (*Hibiscus lasiocarpus*, List 2.2) and Suisun Marsh aster (*Symphyotrichum lentum*, List 1B.2). A fall survey for late-blooming species was conducted within the Mandeville Island study area on October 6, 2009. No rare plants were detected. A spring rare plant survey was conducted at the Old River and the Bacon Island portion of the Connection Slough sites on June 24, 2009. One spring-blooming rare plant was detected – brown fox sedge (*Carex vulpinoidea*, List 2). Rare plant survey results are reported in the Rare Plant Surveys, Two Gates Project Locations letter report (Mosaic Associates, October 7, 2009), enclosed in Appendix G.

A habitat assessment for the federally and state threatened giant garter snake (GGS) (*Thamnophis gigas*) was conducted by Swaim Biological, Inc. (2009). The 2-Gates Project Habitat Assessment for the Giant Garter Snake (*Thamnophis gigas*) (Swaim Biological 2009) is enclosed in Appendix H. Habitat quality is generally good for GGS at all sites within the project area. The main waterways, including the Old River and Connection Slough, are not likely to be preferred habitat, but may provide corridors for movement. Canals within the study areas may also provide GGS habitat. Given the proximity of the Proposed Action to known GGS sightings and suitable habitat at both the Old River and Connection Slough sites, GGS presence is assumed in the project area.

Dry- and wet-season sampling for federally listed large branchiopods, including vernal pool fairy shrimp (*Branchinecta lynchi*), vernal pool tadpole shrimp (*Lepidurus packardi*) and Conservancy fairy shrimp (*Branchinecta conservatio*) consistent with USFWS' Interim Survey Guidelines to Permittees for Recovery Permits under Section 10(a)(1)(A) of the ESA for the Listed Vernal Pool Branchiopods (1996) were conducted in the 0.5-acre wetland on Bacon Island south of Connection Slough in October 2008 (dry season), and November and December 2008, and January, February and March 2009 (wet season) (Helm Biological 2009a, 2009b, 2009c). No listed large branchiopods were detected during the surveys, and since the wetland never ponded water during any of the wet season site visits, the wetland basin was determined to be unsuitable for federally listed large branchiopods. The wet- and dry-season reports, as well as supplementary information on rainfall during the wet-season surveys (Helm Biological 2009c) are enclosed in Appendix I.

Hydrological changes that may affect wetlands and shoreline habitats, both in the immediate vicinity of the gates and in the greater Delta, are discussed in detail in Section 3.9 and Appendices B and L. These analyses, along with aerial photo interpretation, were used to assess the effects of the changed hydrodynamic regimes of the Proposed Action on wetland resources upstream and downstream of the gate locations.

3.5.1 Affected Environment

The study areas on Bacon Island and Mandeville Island consist primarily of uncultivated land, levees, and farm roads surrounding actively farmed agricultural fields that are regularly cultivated. Portions of Holland Tract are under cultivation, but in the study area, the land is fallow or consists of the levee and roadway. Adjacent fields on Holland Tract were utilized as rangeland for cattle at the time of the field visit. Maintenance dredging occurs in the agricultural ditches on all islands.

Most of the land bordering the study areas is farmland, rangeland, or open space. Several unused structures (old farmhouses) are located on Bacon Island near the Old River site; a large barn is located on Holland Tract. An occupied residence and a bunkhouse are present on Mandeville Island near the access bridge.

Levees have been constructed along both banks of Old River and Connection Slough. The roads on the Old River levees are private. The road on the Bacon Island side of Connection Slough is public, while the road on Mandeville Island is private. Periodic levee maintenance includes the control of vegetation and repairs of the riprap above the waterline.

The portion of the Proposed Action on Holland Tract is located in Contra Costa County. The remainder (the Bacon Island and Mandeville Island sites) is located in San Joaquin County. The study areas in which the Proposed Action's effects on terrestrial species and wetland and other waters habitats were evaluated encompass a larger area than the area subject to construction disturbance associated with the construction of the gates. This allowed for a comprehensive analysis of the effects of the Proposed Action on potentially occurring special-status species associated with the construction and operation of the gates.

The Proposed Action would produce modest reductions in water surface elevations in much of the central and southern Delta. The area in which changes in water surface elevation would occur extends from the Sacramento River north of Rio Vista to the San Joaquin River west of Stockton, and Old River south of Grant Line Canal (Figures 3-5.4 – 3-5.7). Based on visual scans of channel islands near the Proposed Action area, a review of aerial photos within the affected environment, and habitat maps developed for black rail (*Laterallus jamaicensis coturniculus*) and Mason's lilaeopsis (*Lilaeopsis masonii,* BDCP 2009a, 2009b), it was determined that habitats in the affected environment include open water, patchy fringes of coastal and valley freshwater marsh along the levees, and coastal and valley freshwater marsh within channel islands. Wetland patches greater than 0.5 acre in size are occasionally within this area on channel islands (BDCP 2009a), and smaller patches of emergent wetland habitat and mudflat areas are present throughout the affected environment (BDCP 2009b). The channel islands near the Proposed Action range in elevation from 3-7 feet NAVD and contain stands of tule (*Schoenoplectus* spp.) and cattails (*Typha* spp.), as well as a mixed riparian woodland component of willow (Salix spp.) and buttonwillow (*Cephalanthus occidentalis var. californicus*) scrub.

3.5.1.1 Special-Status Natural Communities

One special-status natural community is present within the study area – Coastal and Valley Freshwater Marsh. This vegetation community characteristically forms a dense vegetative cover dominated by perennial, emergent monocots 1 to 15 feet high that reproduce by underground rhizomes. This series is most extensive in the upper portion of the Sacramento-San Joaquin River Delta, and is common in the Sacramento and San Joaquin valleys in river oxbows and other areas on the flood plain (Holland 1986). Narrow bands of vegetation, approximately 10 feet wide, along the levee margins fit this description. Nearby islands within the Old River and Connection Slough channels also fit this description, although they are just outside the study area. Narrowleaf cattail (*Typha angustifolia*), tule rush (*Schoenoplectus acutus*), and California bulrush (*Schoenoplectus californica)* are among the dominant hydrophytes of Connection Slough and Old River.

3.5.1.2 Special-Status Species

Special-status plant, fish, and terrestrial species are generally defined as those species that are legally protected or otherwise considered sensitive by federal, state, or local resource conservation agencies and organizations. This includes species protected under the federal ESA, CESA, species identified as sensitive by DFG, and species identified in the CNPS's Inventory of Rare and Endangered Vascular Plants of California (CNPS 2008).

Searches were conducted for sensitive biological resources that have been documented in the USGS Woodward Island, Bouldin Island, Jersey Island, and Brentwood 7.5-minute quadrangles, which cover the proposed sites and vicinity. The nine-quadrangle area recommended by CNPS and DFG protocol was not searched because the range of habitats within a nine-quadrangle search of the surrounding area is much more diverse than the habitats encountered within the study area and within the four-quadrangle search. The four-quadrangle search that was conducted encompasses the habitat types, and therefore the suite of species that may reasonably be encountered in the vicinity of the Proposed Action. The CNDDB also was searched, as were the USFWS-generated list of Federal Endangered and Threatened Species that occur in the four USGS quadrangles listed above; and the CNPS' Inventory of Rare and Endangered Plants of California. Based on these database searches and existing site conditions, animal species having the potential to occur on the proposed sites were identified based on their occurrence in the search area and the presence of habitat suitable for those species. These include Conservancy fairy shrimp (*Branchinecta conservatio*), vernal pool fairy shrimp (*Branchinecta lynchi*), vernal pool tadpole shrimp (*Lepidurus packardi*), giant garter snake (*Thamnophis gigas*), western pond turtle (*Actinemys marmorata*), northwestern pond turtle (*Actinemys marmorata*), Swainson's hawk (*Buteo swainsoni*), tricolored blackbird (*Ageliaus tricolor*), black rail, western burrowing owl (Athene cunicularia), and loggerhead shrike (Lanius ludovicianus).

3.5.1.3 Terrestrial Environment

Habitats present in the study areas include ruderal herbaceous, agricultural cropland, ruderal scrub, coastal and valley freshwater marsh, seasonal wetland, mixed riparian woodland, and planted trees. Figures 3.5-1 and 3.5-2 depict the habitat types present within the study areas. Habitat types are described below.

Ruderal Herbaceous. This habitat type is the most common one found within the study areas. Ruderal herbaceous communities are those that colonize highly disturbed areas. Portions of the study areas receive regular discing maintenance. This habitat type would correspond most closely to Holland's (1986) Pasture series (11206), or to Sawyer and Keeler-Wolf's California Non-Native Grassland series (1995). Dominant herbaceous species observed in the ruderal herbaceous areas included ripgut brome (*Bromus diandrus*), poison hemlock (*Conium maculatum*), Bermuda grass (*Cynodon dactylon*), Mediterranean mustard (*Hirschfeldia incana*), field radish (*Raphanus sativus*), and stinging nettle (*Urtica dioicia*).

Agricultural. Small areas within the study area were under active cultivation for crops such as sunflower (*Helianthus annuus*) and corn (*Zea mays*).

Ruderal Scrub. Ruderal scrub is similar to ruderal herbaceous habitat, in that it is a plant community that colonizes disturbed areas, but instead it is composed of bushy, woody, or taller-

statured species. A few patches of dense, monotypic Himalayan blackberry (*Rubus discolor*) located on Holland Tract and Bacon Island within the Old River study area fit this description.

Coastal and Valley Freshwater Marsh. This series is dominated by cattails up to 4 meters tall, and is most extensive in the upper portion of the Sacramento-San Joaquin River Delta. It is common in the Sacramento and San Joaquin valleys in river oxbows and other areas on the flood plain (Holland 1986). Narrowleaf cattail, tall fescue, and tule rush are among the dominant hydrophytic species along the agricultural ditches and on the levee margins of Connection Slough and Old River. Upstream and downstream of the Proposed Action, this vegetation type also occurs along levees and within channel islands.

Seasonal Wetland. Seasonal wetlands occur throughout the study areas in a variety of geomorphic settings including swales, shallow concave basins, and irrigation ditches and canals; primarily in areas with concave topography and fine textured and/or compacted soils which impede surface water infiltration, or allow groundwater infiltration to occur. The seasonal wetland on Bacon Island near Connection Slough was located in a shallow, sparsely vegetated basin south of the proposed gate. Species that occur in the basin or near the margin include Bermuda grass, umbrella sedge (*Cyperus eragrostis*), knotweed (*Polygonum arenastrum*), and dogbane (*Apocynum cannabinum*). On the Holland Tract, and on Bacon Island near Old River, the seasonal wetlands were dominated by Bermuda grass and water smartweed (*Polygonum amphibium*).

Mixed Riparian Woodland. Although not specifically described in Holland (1986), mixed riparian woodland consists of annual and perennial native and non-native riparian herbaceous and woody species. This vegetation type is typically found along stream and river banks, on terraces adjacent to floodplains, and along perennial or intermittent streams, gullies, springs or seeps. On site, the mixed riparian woodland would conform most closely to Holland's Great Valley Willow Scrub (63410), described as "An open to dense, broadleafed, winter-deciduous shrubby streamside thicket dominated by any of several Salix species. Dense stands usually have little understory or herbaceous component. More open stands have grassy understories, usually dominated by introduced species" (Holland 1986). Mixed riparian woodland on Bacon Island occurs near Old River and includes mostly shrubby willows (*Salix sp.*), most of which are not tall in stature, but do form a dense stand. On Mandeville Island, maps indicate that there is a riparian area nearby the proposed site that may provide mixed riparian woodland habitat composed of willows and scattered cottonwoods (*Populus fremontii*) is present to the north of the study area.

Planted Trees. In a small area around the abandoned farmhouse on Bacon Island at Old River, several planted trees are present, including cottonwood (*Populus fremontii*), apple (*Malus x domestica*), and sweet almond (*Prunus dulcis*).

3.5.1.4 Terrestrial Animals

The proposed sites are located on the Woodward Island and Bouldin Island USGS 7.5-minute quadrangles. Because of the location of the sites near the edges of the quadrangles, the contiguous Brentwood and Jersey Island quadrangles for our analysis of potentially occurring species also were included. A list of terrestrial animal species for these quadrangles contained 12 federally listed species under the jurisdiction of the USFWS and three additional state-listed species (Table 3.5-1). Four species are listed by both the federal ESA and CESA.

Wildlife observed during site visits conducted between August 2008 and October 2009 included: Swainson's hawk, northern harrier (*Circus cyaneus*), western gull (*Larus occidentalis*), barn swallow (*Hirundo rustica*), double-crested cormorant (*Phalacrocorax auritus*), red-winged blackbird (*Agelaius phoeniceus*), bull frog (*Rana catesbiana*), catfish (*Ictalurus* spp.), mink (*Mustela vison*), and ground squirrel (*Spermophilus beecheyi*). Additionally, sign of raccoon (*Procyon lotor*) and coyote (*Canis latrans*) was observed. Virginia rail *(Rallus limicola)* and sora *(Porzana carolina)* could also occur at the proposed sites.

Terrestrial mammal species that may utilize the proposed sites and vicinity include black-tailed jackrabbit (*Lepus californicus*), red fox *(Vulpes)*, gray fox *(Urocyon cinereoargenteus)*, America badger *(Taxidea taxus)*, and long-tailed weasel *(Mustela frenata).* California ground squirrels are present on Bacon Island. Other rodents such as California meadow voles (*Microtus californicus*), house mouse *(Mus musculus)*, deer mouse *(Peromyscus maniculatus)*, and Botta's pocket gopher (*Thomomys bottae*) could also be present at the proposed sites.

Mammals that use aquatic habitat, including the river otter *(Lutra canadensis)* and common muskrat, *(Ondatra zibethicus)* also occur within the proposed sites. Additionally, beaver *(Castor canadensis)* has been documented as occurring in marshes along the lower San Joaquin River (DWR and California State Coastal Conservancy 2008) and has the potential to occur at the proposed sites.

Reptiles that could use habitat within the proposed sites and vicinity include the gopher snake *(Pituophis melanoleucus),* terrestrial garter snake *(Thamnophis elegans),* striped racer *(Masticophis lateralis)* (DWR and California State Coastal Conservancy 2008), GGS, and western and northwestern pond turtles.

No proposed or designated critical habitat for terrestrial species occurs at the proposed sites. Table 3.5-2 provides a list of terrestrial animal species of special concern and indicates whether they have been found on the sites or in the four 7.5-minute quadrangle map area noted above. Several special-status birds and other birds that receive protection under the Migratory Bird Treat Act (MBTA) and the California Fish and Game Code have the potential to nest or forage on the proposed sites and in the vicinity.

Table 3.5-1 Federally Listed and State-Listed Terrestrial Wildlife Species Known from the Vicinity of the Proposed Action

Common Name	Scientific Name	Listing Status[1]		Designated Critical Habitat	Critical Habitat on Proposed Site	Likelihood of Occurrence in Study Area
		Federal	State			
Invertebrates						
Conservancy fairy shrimp	*Branchinecta conservatio*	FE	–	Yes	No	Highly unlikely. Not detected during 2008/2009 surveys.
Longhorn fairy shrimp	*Branchinecta longiantenna*	FE	–	Yes	No	Highly unlikely. Not detected during 2008/2009 surveys.

Table 3.5-1 Federally Listed and State-Listed Terrestrial Wildlife Species Known from the Vicinity of the Proposed Action

Common Name	Scientific Name	Listing Status[1]		Designated Critical Habitat	Critical Habitat on Proposed Site	Likelihood of Occurrence in Study Area
		Federal	State			
Vernal pool fairy shrimp	*Branchinecta lynchi*	FT	–	Yes	No	Highly unlikely. Not detected during 2008/2009 surveys.
Delta green ground beetle	*Elaphrus viridis*	FT	–	Yes	No	Highly unlikely. Atypical habitat.
Vernal pool tadpole shrimp	*Lepidurus packardi*	FE	–	Yes	No	Highly unlikely. Not detected during 2008/2009 surveys. t
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT	–	Yes	No	None. Elderberry host plant is absent.
Amphibians						
California tiger salamander	*Ambystoma californiense*	FT	SSC	Yes	No	None. Site is isolated from occupied habitat.
California red-legged frog	*Rana aurora draytonii*	FT	–	Yes	No	None. Presumed to be extirpated from region due to colonization by introduced species.
Reptiles						
Alameda whipsnake	*Masticophis lateralis euryxanthus*	FT	ST	Yes	No	None. No suitable habitat.
Giant garter snake	*Thamnophis gigas*	FT	ST	No	No	Low. Suitable habitat is present.
Birds						
Swainson's hawk	*Buteo swainsoni*	–	ST	No	No	Moderate. Observed foraging on Bacon Island, 9/8/08, and on Holland Tract 6/24/09. Pair observed in nest tree on east side of Bacon Road, at the SW corner of lower Jones Tract at Middle River.
California black rail	*Laterallus jamaicensis coturniculus*	–	ST	No	No	Moderate. Documented in Old River in study area, and Middle River, near study area in 1992 and 1993

Table 3.5-1 Federally Listed and State-Listed Terrestrial Wildlife Species Known from the Vicinity of the Proposed Action

Common Name	Scientific Name	Listing Status[1]		Designated Critical Habitat	Critical Habitat on Proposed Site	Likelihood of Occurrence in Study Area
		Federal	State			
California clapper rail	*Rallus longirostris obsoletus*	FE	SE	No	No	None. Not known from vicinity of Proposed Action.
Bank swallow	*Riparia riparia*	–	ST	No	No	None. No suitable nesting habitat.
Mammals						
San Joaquin kit fox	*Vulpes macrotis mutica*	FE	ST	No	No	None. Isolated from occupied habitat in region.

Note: Species list developed from the USFWS List of Endangered and Threatened Species that Could Occur or May be Affected by the Project (USFWS 10/13/2009) and the CNDDB occurrences recorded for the Jersey Island, Bouldin Island, Brentwood, and Woodward Island quadrangles, which contain the proposed sites.

[1]Listing status definitions: FT = federally listed as threatened; FE = federally listed as endangered; ST = state listed as threatened; SE = state listed as endangered; SSC = state species of special concern; SFP = state fully protected species.

Table 3.5-2 State Terrestrial Wildlife Species of Concern and Fully Protected Species Known from the Vicinity of the Proposed Action

Common name	Scientific name	Listing Status[2]	Documented to Occur at Proposed Sites	Likelihood of Occurrence in Study Area
Reptiles				
Western pond turtle	*Actinemys marmorata*	SSC	Yes, in three locations 2002	High. Observed in canals adjacent to proposed sites.
Northwestern pond turtle	*Actinemys marmorata*	SSC	No	High. Observed in canals adjacent to proposed sites.
Silvery legless lizard	*Anniella pulchra*	SSC	No	None. No suitable habitat.
Birds				
Tricolored blackbird	*Agelaius tricolor*	SSC	No	Moderate. Suitable habitat is present.
Burrowing owl	*Athene cunicularia*	SSC	No	Unlikely. Suitable habitat is present, but no records from vicinity.
Northern harrier	*Circus cyaneus*	SSC	Yes, observed foraging 6/24/09	Moderate. Suitable habitat is present.
White-tailed Kite	*Elanus leucurus*	DFG Fully Protected	No	Moderate. Suitable habitat is present.
Heron/egret/cormorant rookeries	*Egretta sp, Ardea sp,, Phalacrocorax sp.*	Great blue heron is a "special animal"	No	Moderate. Suitable habitat is present.
Loggerhead shrike	*Lanius ludovicianus*	SSC	No	Moderate. Suitable habitat is present.

Table 3.5-2 State Terrestrial Wildlife Species of Concern and Fully Protected Species Known from the Vicinity of the Proposed Action				
Common name	Scientific name	Listing Status[2]	Documented to Occur at Proposed Sites	Likelihood of Occurrence in Study Area
Mammals				
Western red bat	*Lasiurus blossevillii*	SSC	No	Moderate. Suitable habitat is present.
Note: Species list developed from the CNDDB occurrences recorded for the Brentwood, Woodward Island, Bouldin Island, and Jersey Island quadrangles, which contain the proposed sites, or the presence of suitable habitat. [1]Listing status definitions: SSC = state species of special concern.				

Invertebrates

Focused surveys for the federally threatened vernal pool fairy shrimp, vernal pool tadpole shrimp and Conservancy fairy shrimp were conducted in the 0.5-acre seasonal wetland on Bacon Island at Connection Slough (Helm Biological 2009a, 2009b). Historically, this was not vernal pool fairy shrimp or vernal pool tadpole shrimp habitat, but the levees have isolated the area from the prolonged periods of flooding that occurred historically. No listed large branchiopods were detected, and the wetland was determined to be unsuitable for these species.

The proposed sites, access roads, and 100-foot buffer areas were surveyed for the presence of elderberry shrubs (*Sambucus* spp.), which serve as the host plant for valley elderberry longhorn beetle. No elderberries were detected during these surveys; therefore it is unlikely that the valley elderberry longhorn beetle would be present in the study area.

Amphibians and Reptiles

A habitat assessment by Swaim Biological (2009) concluded that the proposed sites are located within the historic and current range of GGS, and that suitable habitat for the GGS exists within the study areas for the Proposed Action (Appendix H).

The GGS has four main habitat requirements as outlined by the draft recovery plan: (1) adequate water during active season to support prey species (i.e., blackfish [*Orthodon microlepidotus*], Pacific tree frog [*Pseudacris regilla*], carp [*Cyprinus carpio*], mosquito fish [*Gambusia affinis*] and bullfrogs [*Rana catesbeiana*]); (2) emergent wetland vegetation (i.e., cattails [*Typha spp*.]) and bulrushes (*Scirpus spp.)* for foraging habitat and cover from predators; (3) upland habitat with grassy banks and openings in vegetation for basking; (4) higher elevation upland habitats for cover and refuge (i.e., burrows and crevices) from flood waters during winter (USFWS 1999).

Habitat quality for the GGS is generally good at all of the proposed sites. The main waterways, including Old River, are not likely to be preferred habitat, but may provide corridors for movement. These contain the basic features necessary for GGS, including emergent vegetation and cover. The banks of the Old River are lined with rip-rap with interstitial spaces that provide cover from predators and that also may aid in thermoregulation. Much of Old River is also lined by cattails and bulrush. Both plants provide cover and are positively associated with GGS

presence. The results of the habitat features associated with each site are summarized in Table 3.5-3 and discussed in greater detail below.

The west bank of the Old River is adjacent to high-quality GGS habitat. A small canal that runs parallel to the levee road may provide foraging habitat though the deep banks and quantity of emergent vegetation creates a fair amount of shade that may inhibit thermoregulation. The larger, diked canal perpendicular to the levee road provides better foraging habitat for GGS. The banks are moderately sloped with abundant emergent vegetation for cover, and with adequate exposure for thermoregulation. The canal itself appears to have slow-flowing water, and a silt substrate, features positively associated with GGS. Small schools of catfish (*Ictalurus* spp.) are present in the canal. These are generally regarded as predatory game fish, but young catfish may also be a prey source for GGS (USFWS 1999). The levee provides upland habitat and winter refugia above the high water mark. California ground squirrels are absent, but other rodents such as California meadow voles (*Microtus californicus*) are likely present and provide burrows that may be used as retreats for GGS.

The west bank of the Old River site has suitable habitat and there are seasonal wetlands that provide potential forage and cover habitat during the GGS active season that are just to the west across the dirt road. On the east side of Old River, there are wetlands directly fringing the riverbank that comprise the best GGS habitat on the east side of the Old River within the proposed site.

In the Connection Slough site on Bacon Island, the study area is adjacent to an irrigation ditch with shallow water flowing over silt. Abundant bullfrogs and mosquitofish, both prey species for GGS, were observed in the ditch. The presence of bullfrogs suggests that the channel provides water year-round since bullfrog tadpoles do not metamorphose until their second season, overwintering in their larval form. Other crucial habitat features such as emergent vegetation and upland habitat were present at the site. California ground squirrels, whose burrows provide ideal hibernacula for GGS, also were observed. A seasonal wetland south of the proposed gate may provide additional foraging areas in the spring.

The Mandeville Island site contains features that provide moderately suitable habitat for GGS. Water is present year-round in Connection Slough and intermittent patches of emergent vegetation along the levee may provide a degree of foraging habitat in this area. An irrigation canal adjacent to agricultural fields is present north of the levee. At the time of the survey in October 2009, shallow water was present in the canal, but no potential prey items were observed. Emergent vegetation sufficient to provide cover for GGS was present in both the river adjacent to the levee and in the irrigation canal. The upland component is of lower overall quality than the portion located on Bacon Island. Although flooded rice fields and irrigation canals provide cover and forage during the active season, vegetative cover was extremely low and sparse due to grazing and occasional vehicular traffic, and underground refuges were limited primarily to the interstices in the rip-rap on the levee.

Table 3.5-3 Summary of GGS Habitat Features Present at each Site					
Site Location	Water Availability	Prey Species	Emergent Vegetation	Basking sites	Upland Refugia and Burrows
Old River Gate Site	Year-round	Fish present	Present	Present	Present
Connection Slough Gate Site	Year-round	Fish present Bullfrogs present	Present	Present	Present

Western pond turtle (WPT) has been reported on the proposed sites and in their vicinity, and suitable habitat exists onsite for this species. Large woody debris, rip-rap, and shallow water with algal mats or emergent vegetation often harbor WPT. Nesting sites are usually on south or west-facing slopes with bare, clay, or silt soils, or with sparse vegetation of short grasses or forbs, and may be located as much as 0.25 mile from suitable aquatic habitat (Holland 1994). Additionally, there is a record of the northwestern pond turtle northeast of the study area. WPT has recently received some taxonomic study. Formerly this species was called *Clemmys marmorata*. The species phylogeny had been split into two subspecies, a northern (*A. m. marmorata*) and a southern (*A. m. pallida*). The characters used to distinguish the species were, however, ill-defined, and it has been argued that the subspecies distinction should be abandoned, and a new phylogeny should be applied, reuniting the species under *A. marmorata* while recognizing the existence of four distinct clades (Bury and Germano 2008, Spinks and Shaffer 2005). Records for both WPT and northwestern pond turtle exist for the proposed sites, but these subspecies are now considered one species. Regardless of the name applied to the species or subspecies, records for WPT exist on the proposed sites and within the vicinity.

Other special-status amphibian and reptiles, including California red-legged frog (*Rana aurora draytonii*), Alameda whipsnake (*Masticophis lateralis euryxanthus*), California tiger salamander (*Ambystoma californiense*), and silvery legless lizard (*Anniella pulchra pulchra*) are not expected to occur at the proposed sites or vicinity due to the absence of suitable habitat (Alameda whipsnake), isolation from occupied habitat in the region and historic site conditions that were unsuitable (California tiger salamander, silvery legless lizard), or their extirpation from this portion of the Delta due to the mass colonization of introduced fishes and bullfrogs (California red-legged frog).

Birds

Swainson's hawk was observed foraging on Bacon Island on September 8, 2008, and June 24, 2009, and there is a documented nest tree 2.5 miles to the southwest on the Lower Jones Tract along Middle River. Large trees suitable for nesting are present on Holland Tract, Bacon Island, and Mandeville Island near the Proposed Action.

California black rails have been documented in the study area within Old River and in Connection Slough, as well as in Middle River, although no black rail vocal responses were heard anywhere near the proposed sites during recent black rail surveys conducted by DWR (pers. comm., M. Bradbury 2009). The records indicate that the birds were observed on the in-channel islands near the study areas. Black rails use marsh and mudflat habitat, retreating to

areas with dense cover when tides are high. The levee habitats on site provide only marginal cover in high tide situations.

Black rail nest in loosely made deep cups, either at ground level or slightly elevated sites situated in dense marsh vegetation near the upper limit of tidal flooding (DWR 2001). These sites are situated above very shallow water (usually less than 3 cm), but require a perennial water source. A relatively narrow range of conditions is required for occupancy and successful breeding. Water depth is an important parameter for successful nest sites as rising water levels can prevent nesting or flood nests and reduce access to foraging habitat (Eddleman et al. 1994). Too little water will lead to abandonment of the site until the water source is reestablished. Primary factors determining their presence are annual fluctuation in water levels and shallow water depth (<3 cm) (Eddleman et al. 1994, Rosenberg et al. 1991, Conway et al. 2002).

Very little information is available on seasonal patterns, timing of reproduction, dispersal, or other activities. The breeding season begins as early as February with pair formation and extends through approximately early-to-mid June. Egg laying peaks around May 1 (Eddleman et al. 1994).

Suitable habitat for the western burrowing owl is present on Bacon Island near Connection Slough. However, no sign of owl use was observed on September 8, 2008, and the habitat area is small and disconnected from other areas known to host burrowing owl.

The tricolored blackbird and the loggerhead shrike have the potential to occur onsite due to presence of suitable habitat. Habitat suitable for bank swallow (*Riparia riparia*) nesting is absent from the proposed sites.

Large trees are present on the Holland Tract, Old River site, both within the study area (within the "mixed riparian woodland" in Figure 3.5-1), and within 0.25 miles of the study area on Holland Tract to the northwest and the south. Large trees that could serve as potential nesting sites for other raptors and migratory birds are also located within 0.25 mile of the Mandeville Island study area, and the study area does provide foraging habitat for Swainson's hawk, northern harrier, white tailed kite (*Elanus leucurus*), and other birds of prey. Northern harriers are a ground nesting species, establishing their nests in undisturbed patches of dense, tall vegetation (Shuford 2008). Northern harriers were observed foraging in the vicinity of the proposed sites on June 24, 2009. White tailed kite build nests placed near top of dense oak, willow, or other tree stands; usually 6 to 20 meters (20-100 feet) above ground (Dixon et al. 1957). Suitable nesting habitat is present in the riparian scrub and the planted trees for these and other birds covered under the MBTA.

Large wading bird species, such as the great blue heron, great egret (*Ardea alba*), and double-crested cormorants usually nest in colonies on the tops of secluded tall trees or snags; usually the tallest available (Zeiner et al. 1988-1990). No heron, egret, or cormorant rookeries have been observed on the proposed sites.

Mammals

San Joaquin kit fox (*Vulpes macrotis mutica*) are not expected to occur at the proposed sites due to the lack of connectivity between known kit fox occurrences and the proposed sites, with the rivers and sloughs creating barriers to movement.

The western red bat (*Lasiurus blossevillii*) has the potential to roost on in structures and trees in or near the study area. The abandoned farmhouse structures on Bacon Island; a barn located on the Holland Tract; and large mature trees on Bacon Island, Holland Tract, and on Mandeville Island could serve as potential roosting habitat; however, there were no incidental observations of bats or sign of bats during any of the surveys reported in this section. The structures on Mandeville Island northwest of the study area are occupied, so do not provide habitat for the western red bat. The structures and large trees present within the study area would not be disturbed, so the Proposed Action would not affect this species.

3.5.1.5 Plants

A 2008 and 2009 CNDDB and CNPS search identified locations of special-status plant species within a four-quad radius of the proposed sites (Bouldin Island, Woodward Island, Jersey Island, and Brentwood 7.5 minute quadrangles). Eighteen plant species listed either under ESA or CESA or on the CNPS list are shown in Table 3.5-4. Soft bird's beak, Delta button-celery, and Antioch Dunes evening primrose were the only special-status plant species documented to occur within the four-quadrangle search surrounding the proposed sites.

Table 3.5-4 Special-Status Plant Species

Common Name Scientific Name	Potential to Occur in Study Area	Listing Status[1]		
		Federal	State	CNPS
Heartscale *Atriplex cordulata*	Very low. Some very marginal habitat present, but no alkaline soils observed.	–	–	List 1B
San Joaquin spearscale *Atriplex joaquiniana*	Very low. Some very marginal habitat present, but no alkaline soils observed.	–	–	List 1B
Big tarplant Blepharizonia plumosa	Very low. Some very marginal habitat present, but no occurrences reported. Grasslands on site receive regular disking.	–	–	List 1B
Round-leaved filaree *California macrophylla*	Low. Grasslands on site receive regular disking	–	–	List 1B
Bristly sedge *Carex comosa*	Moderate. Suitable habitat present in levee margins.	–	–	List 2
Brown fox sedge *Carex vulpinoidea*	Present. Documented to occur on study area (Old River) in spring 2009. Has potential to occur on levee margins.	–	–	List 2
Soft bird's-beak *Cordylanthus mollis ssp. mollis*	Very Low. Other halophytes do not occur in the study areas.	FE	SR	List 1B
Delta button-celery *Eryngium racemosum*	Low. May occur in Riparian Scrub on Mandeville, if present. Marginal habitat present.	--	SE	List 1B
Woolly rose-mallow *Hibiscus lasiocarpus*	Present. Also detected on islands of Old River in 1992. Suitable habitat present on levée margins. Detected on Bacon Island in summer 2008.	–	–	List 2

Table 3.5-4 Special-Status Plant Species

Common Name Scientific Name	Potential to Occur in Study Area	Listing Status[1]		
		Federal	State	CNPS
Delta tule pea *Lathyrus jepsonii var. jepsonii*	Low. Has potential to occur on levee margins.	–	–	List 1B
Mason's lilaeopsis *Lilaeopsis masonii*	Moderate to High. Documented as occurring on study area (Old River) in 2002; has potential to occur on levee margins.	–	SR	List 1B
Delta mudwort Limosella subulata	Low. Documented as occurring near study area, but mudflat habitat does not occur in study area.	–	–	List 2
Antioch Dunes evening-primrose *Oenothera deltoides ssp. howellii*	None. Dune habitats not present within the study areas.	FE	SE	List 1B
Eel-grass pondweed *Potamogeton zosteriformis*	Moderate. Suitable habitat present within aquatic habitats.	–	–	List 2
Marsh skullcap *Scutellaria galericulata*	Moderate. Suitable habitat present in levee margins.	–	–	List 2
Side-flowering skullcap *Scutellaria lateriflora*	Moderate. Suitable habitat present in levee margins.	–	–	List 2
Suisun Marsh aster *Symphyotrichum lentum*	Present. Documented in Old River north of study area; suitable habitat present in levee margins. Detected on Bacon and Holland in summer 2008.	–	–	List 1B
Caper-fruited tropidocarpum *Tropidocarpum capparideum*	Very low. No alkaline soils observed.	–	–	List 1B

1FE = federally listed as endangered; SE = state listed as endangered; SR = state listed as rare; List 1B = rare, threatened, or endangered in California and elsewhere; List 2 = Rare, threatened, or endangered in California, but more common elsewhere.

Source: DFG 2008 & 2009, and CNPS 2008 & 2009. Data compiled by Mosaic Associates in 2008 & 2009.

Plants that rate a moderate or higher likelihood of presence based on an analysis of the habitats present within the study area and upon documented occurrences of the species within the study area and within the four-quadrangle search area surrounding the proposed sites, merit the conduct of rare plant surveys. The following eight special-status plant species with a moderate or higher potential to occur with in the study area were identified:

- Brown fox sedge (*Carex vulpinoidea*): Has been documented on the proposed Bacon Island site on the bank of Old River in June 2009. Flowering Period: May-June.
- Bristly sedge (*Carex comosa*): Has the same habitat requirements as *Carex vulpinoidea*, which has been documented on the proposed site. Flowering Period: May to September. Not detected during summer rare plant surveys on Bacon Island and Holland Tract.
- Woolly rose-mallow (*Hibiscus lasiocarpus*): This plant was observed on the levee margin of Bacon Island at Old River during the September 2008 rare plant survey. It has been documented within the islands of Old River near the study area and on the levee margins just south of study area. Flowering Period: June to September. Detected on Bacon Island.

- Mason's lilaeopsis (*Lilaeopsis masonii*): 68 records within the four-quadrangle search; and 4 within the study area. Flowering Period: April to November. Not detected during summer rare plant surveys on Bacon Island and Holland Tract.
- Eel-grass pondweed *Potamogeton zosteriformis*: May occur in aquatic habitats on site, though none was observed during the summer rare plant survey. Flowering Period: June to July. Not detected during summer rare plant surveys on Bacon Island and Holland Tract.
- Marsh skullcap (*Scutellaria galericulata*): Occurs in marshes and swamps, suitable habitat is present on levee margins, though none was observed during the summer rare plant survey. Flowering Period: June to September. Not detected during summer rare plant surveys on Bacon Island and Holland Tract.
- Side-flowering skullcap (*Scutellaria lateriflora*): Occurs in marshes and swamps, suitable habitat is present on levee margins, though none was observed during the summer rare plant survey. Flowering Period: July to September. Not detected during summer rare plant surveys on Bacon Island and Holland Tract.
- Suisun Marsh aster (*Symphyotrichum lentum*): This species occurs on the levee margins of Old River, with one individual on the Bacon Island side, and several dispersed on the Holland Tract side. It has been documented near the proposed site in Old River islands. Flowering Period: May to November. Detected on Bacon Island and Holland Tract during September 2008.

A rare plant survey for summer-blooming target species was conducted on September 23, 2008 at the Old River site and on September 29, 2008 on the Bacon Island side of Connection Slough. A rare plant survey was conducted on the Mandeville side of Connection Slough on October 6, 2009 for fall-blooming plants. A rare plant survey for spring-blooming target species was conducted on the same sites, exclusive of Mandeville Island, on June 24, 2009. Three species – brown fox sedge, woolly rose mallow, and Suisun marsh aster were detected within the study area (Figure 3.5-1).

The following four summer-blooming species with a moderate to high potential for occurrence were not detected during the surveys: bristly sedge, Mason's lilaeopsis, marsh skullcap, and side-flowering skullcap. In relation to Delta mudwort, although there are records in the vicinity, mudflat habitats suitable for this species are absent in the levee areas. Absence of such mudflat habitat greatly reduces the likelihood of this species' presence, and it was not observed during the summer rare plant survey. Additionally, the nativity of this species is under scrutiny; the Jepson Manual (Hickman 1993) lists it as a non-native.

The eight summer-blooming special-status species with a very low or low potential to occur were not detected during the summer rare plant survey. These included: heartscale (*Atriplex cordulata*), San Joaquin spearscale (*Atriplex joaquiniana*), big tarplant (*Blepharizonia plumosa*), soft bird's beak (*Cordylanthus mollis ssp. mollis*), Delta button-celery (*Eryngium racemosum*), Delta tule pea (*Lathyrus jepsonii var. jepsonii*), Delta mudwort and Antioch Dunes evening-primrose (*Oenothera deltoids ssp. howellii*).

A survey for spring-blooming species at the Old River site and on the Bacon Island side of Connection Slough was conducted on June 24, 2009. One brown fox sedge plant was detected on

the Bacon Island bank of Old River. The other spring-blooming species with potential to occur, including round-leaved filaree (*California macrophylla*) and caper-fruited tropidocarpum (*Tropidocarpum capparideum*), and eel grass pondweed (*Potamogeton zosteriformis*) were not detected during the spring rare plant survey.

A fall rare plant survey was conducted on Mandeville Island, and a spring rare plant survey will be conducted in May or June 2010, prior to the onset of construction. It is unlikely that any rare plant species would be found on the landward side of the levee because the hillsides are regularly disked, and agricultural ditches are dredged to control vegetation and weed growth. Rare plants may be present on the river side of the levee where suitable habitat for the species with potential to occur is present.

3.5.1.6 Wetland Resources and Other Waters

A preliminary wetland delineation of the study areas on Holland Tract and Bacon Island was conducted in August and September 2008 and on Mandeville Island on October 6, 2009 (Appendix F, Mosaic Associates 2009). Table 3.5-6 provides the acreage of potentially jurisdictional wetlands and other waters of the U.S. within the Study Areas defined for the Proposed Action. The delineation defined tidally influenced wetlands and other waters, as well as non-tidal seasonal wetlands considered likely to be subject to the jurisdiction of the Corps, and agricultural ditches that were unlikely to be jurisdictional features.

3.5.2 Regulatory Setting

The following laws and regulations related to terrestrial biological resources are applicable to the Proposed Action.

Federal Endangered Species Act

The ESA of 1973 and as amended in 1988 establishes a national program for the conservation of threatened and endangered species of fish, wildlife and plants and the preservation of the habitat critical to the survival of listed species. The purpose of the ESA is to conserve the ecosystems upon which the endangered and threatened species depend and to recover listed species. Under the ESA, species may be listed as either "endangered" or "threatened." "Endangered" is defined as a species in danger of extinction throughout all or a significant portion of its range. "Threatened" is defined as a species likely to become endangered within the foreseeable future.

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 designated critical habitat.

Section 7(a) of the ESA requires federal agencies to ensure that the actions they authorize or fund, and carry out do not jeopardize species listed as threatened or endangered or their critical habitats. As defined in the act, the lead federal agency may request consultation with USFWS and/or NMFS (collectively referred to as "the Services") if the lead agency has reason to believe

that a listed species is likely to be affected by a proposed action. The lead federal agency prepares a BA which is reviewed by the Services. The responsible service or Services issues a BO regarding how the proposed action will affect listed species or critical habitat. If the Services determine that a proposed action will jeopardize the continued existence of a listed species, or interfere with its recovery, the Services must issue a BO offering RPAs about how the proposed action could be modified to avoid jeopardy.

Clean Water Act, Section 404

Section 404 of the CWA establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Section 404 discharges are addressed in Section 3.4 of this document.

Rivers and Harbors Act, Section 10

Section 10 of the Rivers and Harbors Act (33 U.S.C. 401 et seq.) requires authorization from the Corps for the construction of any structure in or over any navigable water of the United States, the excavation/dredging or deposition of material in these waters or any obstruction or alteration in a navigable water. Structure or work outside the limits defined for navigable waters of the U.S. require a §10 permit if the structure or work affects the course, location, condition, or capacity of the water body.

Migratory Bird Treaty Act (MBTA)

The MBTA, first enacted in 1918, implements various treaties and conventions between the U.S. and Canada, Japan, Mexico and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing or possessing migratory birds is unlawful. Unless permitted by regulations, the Act provides that it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not. Actions that are likely to result in take of birds protected under the MBTA require the issuance of take permits from the local USFWS jurisdiction. Birds protected under the act include all common songbirds, waterfowl, shorebirds, hawks, owls, eagles, ravens, crows, native doves and pigeons, swifts, martins, swallows and others, including their body parts (feathers, plumes etc), nests, and eggs.

3.5.3 Environmental Consequences

3.5.3.1 No Action Alternative

The No Action alternative would not affect terrestrial species because no development would occur.

3.5.3.2 Proposed Action

This section focuses on potential impacts at the proposed sites along Old River and Connection Slough. If all of the dredged sediment cannot be accommodated at the Bacon Island disposal area, use of the Roberts Island #1 disposal site would be required. Use of this additional disposal site would not result in added impacts to terrestrial biological resources because it is an existing disposal site, and disposal activities would comply with all permit conditions.

Three habitat types would be affected by construction of the Proposed Action: coastal and valley freshwater marsh, ruderal herbaceous and other waters. Table 3.5-5 quantifies the impact of construction of the Proposed Action on habitats.

Table 3.5-5 Impacts to Habitats

Habitat Type	Location	Construction Impacts[1] (acres)	5-year[2] (acres)	Permanent[3] (acres)
Coastal and Valley Freshwater Marsh	Connection Slough	0	0.08	0
	Old River	0	0.18	0
Ruderal Herbaceous	Connection Slough NORTH	1.78	0	<0.0001
	Connection Slough SOUTH	0.69	0	4.47
	Old River EAST	0.07	0	<0.0001
	Old River WEST	1.55	0	<0.0001
Other Waters	Connection Slough	0	1.10-1.32	0.44
	Old River	0	0.71-1.22	0.55
Totals		4.09	2.07-2.80	5.46

Notes:

1. Construction Impacts include temporary disturbances during construction only within the laydown areas.

2. 5-year impacts include structures in place during the duration of the 5-year demonstration project, most of which will be removed thereafter. The actual area of impact to other waters depends on the size of barge used for the gates.

3. Permanent impacts include fill and sheet piles that would remain in place when other structures are removed. Impacts to ruderal herbaceous habitats include sheet piles within the levees, toe berm reinforcement, and fill in the dredged materials disposal area. Impacts to other waters includes sheet piles and sand fill in the toe enclosures.

Common Species

Suitable habitat for mammals, including ground squirrels, voles, mice, gophers, weasels, and foxes, as well as for reptiles, including the gopher snake, garter snake, and striped racer, is present within the proposed sites. Construction activities that could disturb these animals include the storage or removal of existing structures and debris, and disposal of dredge spoils. Vehicle movement, grading, and installation of sheet piles and the gate structures could have temporary effects on existing habitat and on animal activity. Construction noise and vibrations could result in the avoidance of the area by commonly occurring species during construction.

These land-based disturbances would be limited to a relatively small area and would be confined to the period between June and November. Short-term effects on habitat used by reptiles and burrowing mammals would be followed by recolonization of those areas disturbed during construction. Therefore, proposed construction would have a temporary, minor impact on burrowing mammals and reptiles. Proposed activities are also unlikely to affect commonly occurring birds such as red winged blackbird, tree swallow, killdeer, black-necked stilt, great egret and sora because construction would occur outside of the nesting season of most birds (mid-March to late July). Gate operations would not affect nesting and foraging habitat, since operations are not expected to disturb habitat and birds within and in the vicinity of operations

would presumably be habituated to daily operations. Gate removal would take place from the water, so no impacts to commonly occurring mammals, reptiles, or birds are anticipated.

The Proposed Action consists of temporary actions such as the construction and removal of project facilities. Aquatic animals such as river otter, common muskrat, and beaver may be present at either site. During construction and removal of project facilities, aquatic animals may be temporarily displaced, returning to the area upon completion of work. Direct impacts are unlikely to occur as aquatic animals would move away from areas where equipment is in operation. As the Proposed Action includes operation of two gates over a five-year period, aquatic animals could be impacted indirectly by the presence of gate operations staff, and activity associated with operation of the gates. After some time, it is anticipated that most animals would become accustomed to the presence of the gates. A small portion of the aquatic environment would be modified for the placement of the barges, and then restored after a five-year period. Overall, construction and removal of the facility would have a temporary and minor impact on aquatic animals. During the five-year life of the Proposed Action, operation of the two gates would have a minor impact on aquatic animals.

Special-Status Species

Impacts of the Proposed Action on special-status animal and plant species are described below. No impacts on other federally listed, proposed, or candidate terrestrial species or destruction or adverse modification of proposed or designated critical habitat would occur as a result of the implementation of the Proposed Action. Impacts on the species described below would be short-term, occurring only during facilities construction and removal activities, and they would be minor because adequate provisions would be incorporated into the Proposed Action to reduce or avoid adverse impacts (refer to environmental commitments BIO-1 through BIO-9 as described in Section 2).

Giant Garter Snake

Habitat suitable for GGS is present at both gate locations. The proposed sites are within habitat designated for the recovery of the species, and GGS is assumed to be present. Construction of the Proposed Action has the potential to take individual snakes if they are present in the area subject to disturbance. GGS are active during the summer (season defined as May 1 to September 30) and hibernate in upland burrows and refugia during the winter (season defined as October 1 to April 30). Construction is expected to take place during the active season, but the effects of construction on GGS during both the active and dormant season are discussed to address the effects of the Proposed Action in the event that there are changes in the construction schedule.

During the active period for GGS, a take of snakes could occur during the movement of construction equipment and other vehicles, the removal of debris, rock and vegetation, grading, deposition of dredge spoils and by the installation of the sheet piles, the gate structures, and new power poles. During the dormant period, GGS could be crushed or entombed during grading, the installation of the sheet piles on the levees, dredge spoil disposal and the removal of debris or rock in which snakes could be hibernating, or hibernating snakes could be exposed during earthwork.

Construction may result in a temporary loss of habitat for GGS as upland refugia and burrows suitable for hibernation may be crushed by earthmoving equipment, and debris piles that function

as upland refugia are removed from within the laydown areas to accommodate construction activities. This would be a short-term impact to habitat as burrowing mammals would likely recolonize areas disturbed during construction. The most significant land-based disturbance would occur during construction between June and September (during the active season).

Figure 3.5-3 shows the areas of upland and aquatic GGS habitat that would be impacted during gate construction. Upland habitat includes areas above the high tide line subject to disturbance during construction, while aquatic habitat includes areas of emergent vegetation within the proposed construction area. Up to six poles would be installed to supply power to the gates (see Figures 2-7 and 2-8). The poles would be installed in upland habitat, and except for three poles at the Connection Slough site, would be situated within impact areas identified on Figure 3.5-3. At Connection Slough, three of the new poles would be installed at the landward base of the levee outside of, but immediately west of the impact area identified in Figure 3.5-3. These new poles would be installed in highly disturbed ruderal habitat that is largely devoid of cover or potential refugia, and would result in the disturbance of less than 0.01 acre of upland habitat. At the Old River gate location, approximately 1.62 acres of upland habitat and 0.18 acres of aquatic habitat would be affected during construction, while at the Connection Slough gate, approximately 6.94 acres of upland habitat and 0.08 acres of aquatic habitat would be affected during construction.

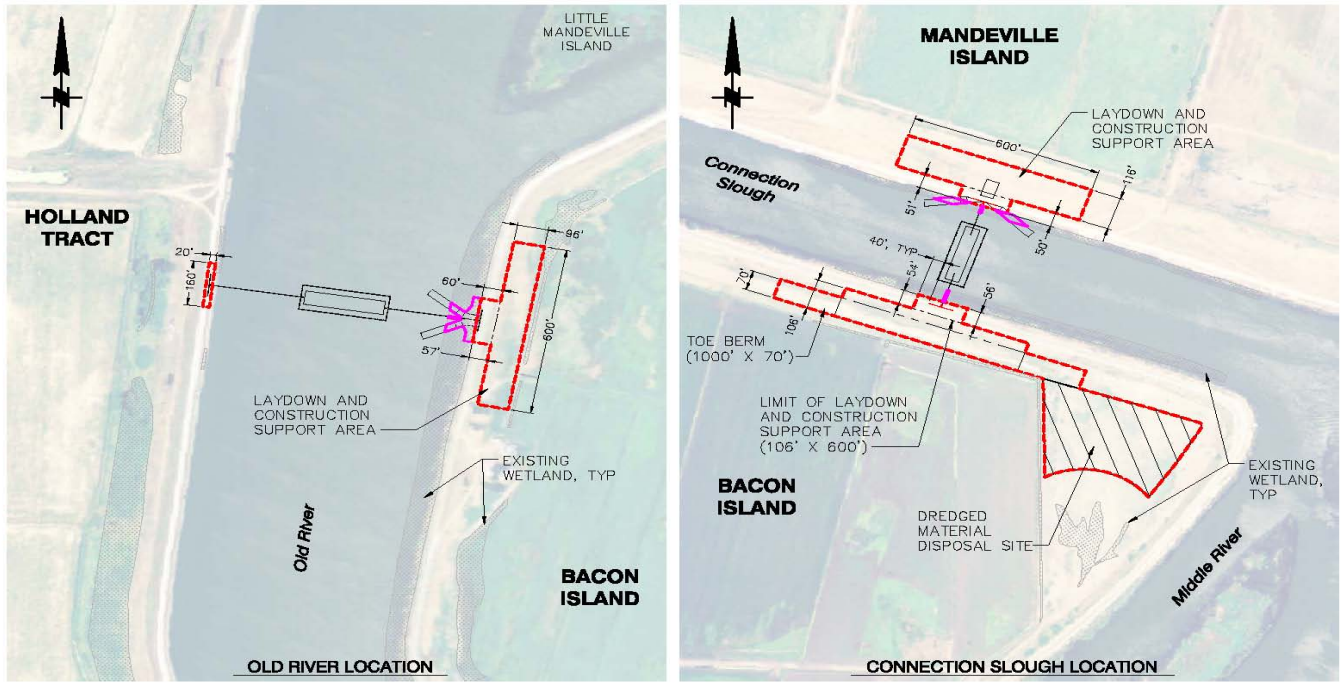
Installation activities during October and November would involve access along the roads, but would not impact GGS because there would be no earthmoving work that could disturb, expose or entomb GGS hibernating in upland refugia, and GGS would not be present above ground on roadways. Environmental Commitment BIO-1 would require the conduct of preconstruction surveys, biological monitoring during construction, and the implementation of a number of protection measures, such as minimizing habitat disturbance, worker environmental awareness training, and exclusionary fencing. Although initial construction is expected to occur during the active period for GGS, measures have been included that would reduce or avoid impacts should construction be delayed until the dormant season. They also would apply to facilities removal activities should they occur during the dormant season. Table 3.5-6 describes GGS conservation measures for the Proposed Action that have been adapted from the *Programmatic Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter and Yolo Counties, California* (USFWS 1997). Given the implementation of BIO-1, impacts to GGS from construction would be short-term and minor.

Proposed operations would not affect GGS or impede their movement. The snakes are highly mobile and would be able to move around the sheet piles on the levees.

Western and Northwestern Pond Turtle

Western pond turtle (and the subspecies, northwestern pond turtle) has been documented to occur in the canal west of the Old River site on Holland Tract, on the channel islands north of the Old River study area, and to the south, on Old River. Construction and removal of the proposed facilities may impact western or northwestern pond turtles if present within the study area. Environmental Commitment BIO-2 requires that not more than 48 hours prior to the start of site disturbance, a qualified biologist familiar with WPT behavior would conduct focused visual surveys for western pond turtles and any nesting activity (i.e., nests, egg shell fragments) in the study area, silt fencing around the perimeter of the laydown area, and supervision of vegetation

removal within the laydown areas by a qualified biologist. Measures also have been included to address procedures to be followed if juvenile or adult WPT are found on the Project site or if a nest is found in the construction area. A worker environmental training awareness program also would be implemented. Given the implementation of BIO-2, impacts to WPT from construction would be short-term and minor.



IMPACT AREAS

	UPLAND		AQUATIC	
	(SF)	(AC)	(SF)	(AC)
OLD RIVER – WEST	3,200	0.07	0	0
OLD RIVER – EAST	67,375	1.55	8,005	0.18
TOTAL OLD RIVER	70,575	1.62	8,005	0.18
CONNECTION SLOUGH – SOUTH	224,825	5.16	290	0.01
CONNECTION SLOUGH – NORTH	77,670	1.78	3,165	0.07
TOTAL CONNECTION SLOUGH	302,495	6.94	3,455	0.08

Figure 3.5-3 Giant Garter Snake Habitat Impact Areas

Table 3.5-6 Summary of Giant Garter Snake Conservation Measures			
Construction Timing Alternative	Duration of Impacts / Time of Year	Type and Area of Impacts (acres)	Conservation Measure: Compensation
October 1 through April 30	Temporary (2 seasons) / impacts to occur during dormant season	Upland habitat: 8.56 acres Aquatic habitat: 0.26 acres	Restoration and up to 6:1 replacement *Restoration*: Restore salvaged refugia and revegetate habitats disturbed during construction *Replacement*: Upland habitat: 51.4 acres Aquatic habitat: 1.6 acres
May 1 through September 30	As above / impacts to occur during active season	As above	Restoration plus 1:1 replacement *Restoration*: Restore salvaged refugia and revegetate habitats disturbed during construction *Replacement*: Upland habitat: 8.6 acres Aquatic habitat: 0.3 acres

Proposed operations would not affect these species since operations would not alter their habitat or involve actions that could pose a direct or indirect threat to these mobile animals.

Western Burrowing Owl

There are no CNDDB records of burrowing owls, a state species of concern and MBTA listed, in the Bouldin Island or Woodward Island topographic quadrangles surrounding the Old River and Connection Slough sites. However, suitable habitat for burrowing owls is present on Bacon Island at Connection Slough, as an abundance of ground squirrel burrows are present in the laydown and spoil disposal areas. Land-based construction activities, including the installation and removal of sheet piles, pile-supported boat ramps, clearing, grading, the storage or movement of rock or other construction materials, or disposal of dredge spoils could result in a direct take of individuals or result in the failure of an active nest, if burrowing owls are present in the disturbance area.

Environmental Commitment BIO-3 requires surveys for western burrowing owl and avoidance or mitigation for owls, if present; and implementation of a worker environmental training awareness program, in compliance with the CBOC's Burrowing Owl Survey Protocol and Mitigation Guidelines (1993) and the DFG Staff Report on Burrowing Owl Mitigation (1995).

Given the implementation of BIO-3, impacts to burrowing owls from construction would be short-term and minor.

Proposed operations would not have any impacts on burrowing owls since the operations would not require land-based earthwork.

Swainson's Hawk

Swainson's hawk has been observed foraging on site and could nest in trees on Holland Tract, Bacon Island at Old River and Mandeville Island that are located within 0.25 mile of the proposed sites.

Construction and removal of the proposed facilities could affect Swainson's hawk nesting behavior because construction and removal activities would occur during the nesting season (mid-March to late July), and suitable nesting habitat is located within 0.25 mile of the proposed site. The new power poles installed for the Proposed Action would provide roosting habitat, which could result in accidental electrocution.

Environmental Commitment BIO-4 requires preconstruction surveys for Swainson's hawk prior to construction and implementation of avoidance or mitigation activities, if present. These may include postponing site disturbance until a qualified nest monitor determines that the young birds have fledged and are no longer reliant on the nest site or nest monitoring by a biologist with stop-work authority in the event of disturbances to nesting behavior, and a reduced no-disturbance buffer if site conditions suggest that a reduced buffer area would not disturb nesting behavior (based on amount and type of ongoing disturbance, such as farm activities, boating, traffic, etc.). The power poles would include Raptor Protection measures, including the installation of a deflector to prevent birds from roosting on the lines. Given the implementation of BIO-4, impacts to Swainson's hawk from construction would be short-term and minor.

Proposed operations would not result in impacts to Swainson's hawk. Nesting and foraging habitat would not be impacted by gate operations, since operations are not expected to disturb habitat, and birds nesting in proximity to the gates would presumably be habituated to ongoing operations since operations would begin prior to the nesting season.

Black Rail

Black rail has been documented to occur in the dense emergent wetland habitat on the islands in Old River and Connection Slough, although no black rail vocal responses were detected during recent surveys by DWR (personal communication, M. Bradbury 2009). Potential nesting and foraging habitat for this species is present on the channel islands located approximately 0.18 and 0.35 mile north of the Old River gate, in the emergent wetland vegetation on the east bank of Old River, and in the wetlands along Connection Slough. The potential for it to be present in the construction area is low, however, due to the limited extent of this habitat on the bank of the river and the steep gradient of the banks.

Construction activities could affect nesting behavior of black rail, if present near the gate locations, because construction activities would coincide with the nesting season. Removal of the gates and boat ramps between July and November would take place towards the end or after the

nesting season. Construction and removal activities could adversely affect the nesting behavior of this species, if occupied nests are present.

Environmental Commitment BIO-5 requires preconstruction surveys for black rail prior to gate construction and removal activities and avoidance or mitigation activities, if present. Such measures may include a delay in gate construction or removal until young birds are foraging independently and nest monitoring by a qualified biologist determines that construction or removal operations do not pose a risk to nest habitat. Given the implementation of BIO-5, impacts to black rail from construction would be short-term and minor.

Proposed operations have the potential to change the area of suitable black rail habitat by altering the depth of water in nesting habitat, flooding or drying habitat, or reducing access to foraging habitat. Operations would temporarily alter tidal elevations during the nesting season, although all water surface elevations would be within the range of existing tidal action. Upstream of the gates, operations in March would reduce the elevation of mean high water; while the cessation of operations between April and May, during the height of the nesting season, would restore the elevation of mean high water to current conditions. The elevation of mean high water would be reduced again during June.

The effects of the Proposed Action on mean high water during March and June were modeled to determine the magnitude of the change (Section 3.9). Both upper bound and lower bound conditions were analyzed to assess the effects during different CVP and SWP operational scenarios. Generally, the reduction in mean high water in Old and Middle rivers south of the gates would be larger during upper bound operations and of slightly greater magnitude during March than in June.

During gate closures in March, the channel islands in Old and Middle rivers upstream of the gates that support suitable nesting habitat would experience decreases in the elevation of mean high water from current operations from an estimated 13 inches near the Old River Gate to 12 inches near Woodward Canal (Figures 3.5-4 and 3.5-5). In Middle River, the effect would range from 2 inches near Railroad Cut to 6 inches between Woodward Canal and SR 4. During June, the elevation of mean high water would drop approximately 11 inches from the Old River gate to Woodward Canal, while in Middle River the drop would range from about 3 inches at Railroad Cut to 7 inches near Woodward Canal and SR 4.

Changes in the hydrologic regime during the nesting season could alter nesting behavior, although the specific effects of the Proposed Action on the behavior of this secretive bird are uncertain. The selection of nesting sites is likely based on water depth in fringe habitats above the high tide line as well as local vegetative structure; a change in the hydrologic regime at the end of March would occur within known pair bonding and nesting times for the species and quite possibly after nest site selection has been made. The effect of a change in hydrologic conditions at this time is not known. The reduction in the elevation of mean high water could reduce the depth of water in nesting habitat to below the narrow range of tolerances for this species, and thus could reduce the area of suitable nesting habitat known from this area. A greater area of mudflat habitat would likely be exposed on the channel islands and wetlands fringing the levees during operations. Water surface elevations would be restored to those sustained under current conditions during April and May, which would coincide with the peak nesting season.

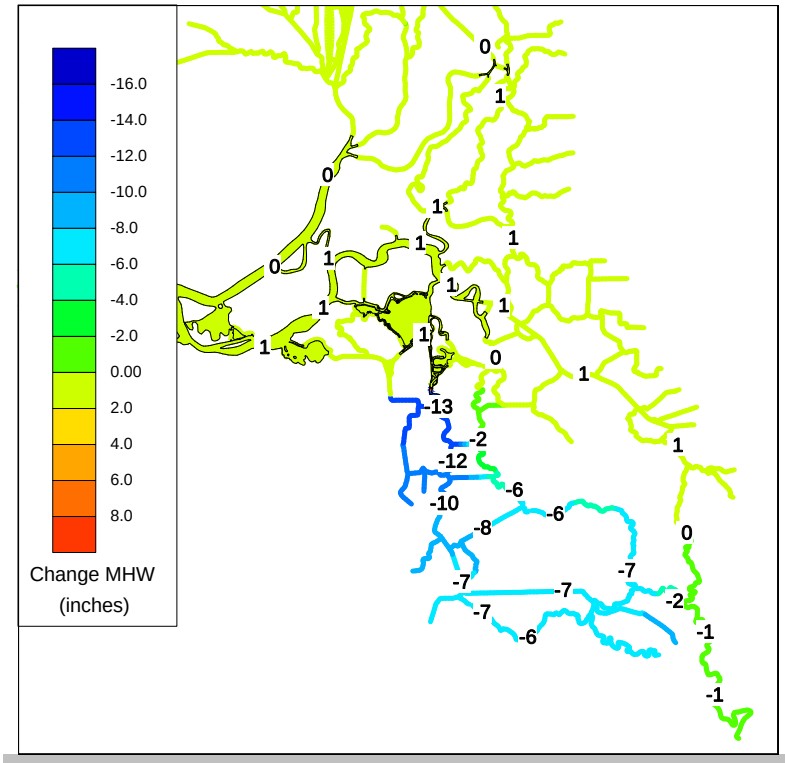


Figure 3.5-4 Change in Mean High Water, Upper Bound Conditions, March 2004

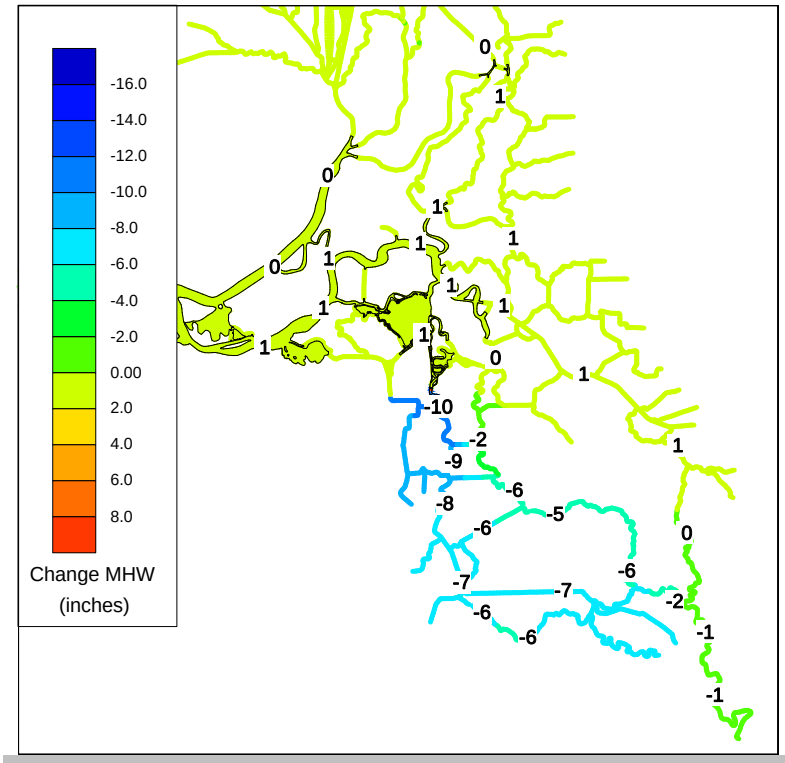


Figure 3.5-5 Change in Mean High Water, Lower Bound Conditions, March 2004

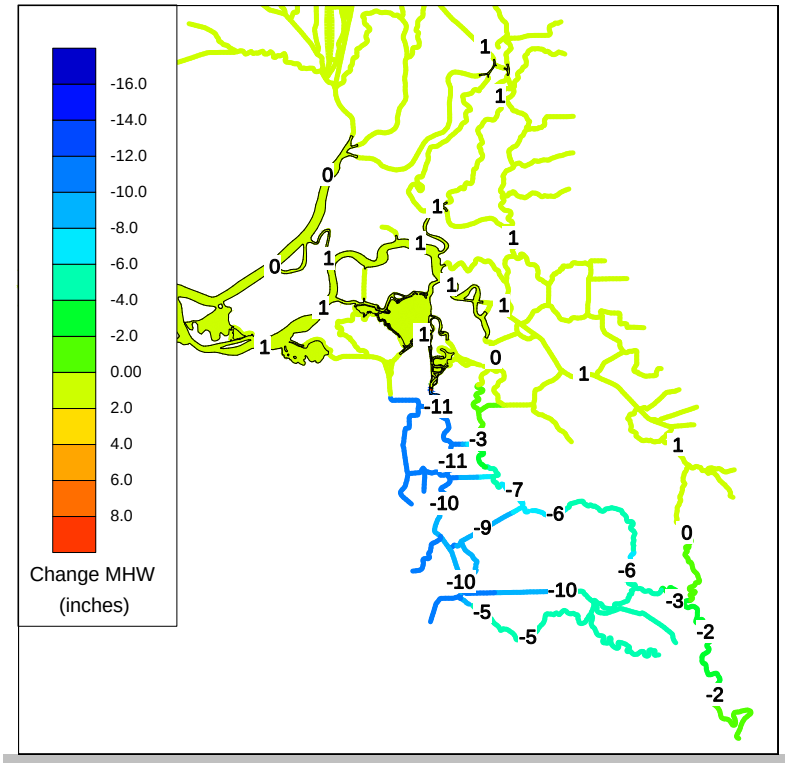
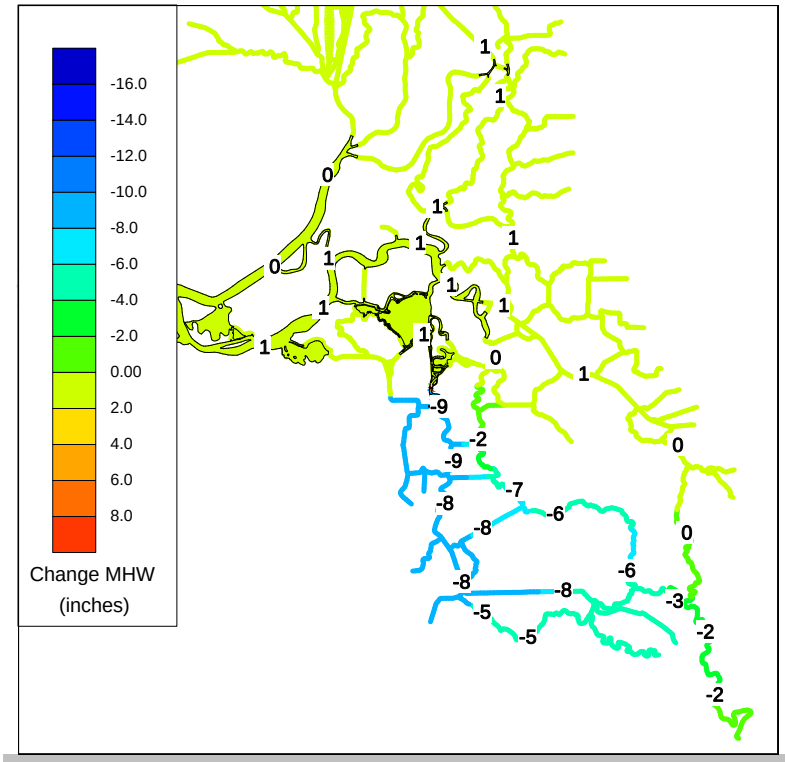


Figure 3.5-6 Change in Mean High Water, Upper Bound Conditions, June 2004



Figures 3.5-7 Change in Mean High Water, Lower Bound Conditions, June 2004

Downstream of the gates, gate operations would produce an increase in the elevation of mean high water of approximately 1 inch in March and June. Due to the small magnitude of the increase in water surface elevation against the background of routine fluctuations due to storms and daily tidal exchanges, the change in water surface elevation downstream of the gates is not expected to have an effect on black rail nesting or foraging habitat.

Gates would be open during flood events, producing less than a 0.1-foot change in flood stage elevations in a 100-year event, so the disturbance of low-lying nesting habitat or refugia during flood events is unlikely.

Proposed Action operations would increase the exposure of black rail to methyl mercury (MeHg). Tidal marshes throughout the Delta contain sediments contaminated with MeHg, which is associated with wetting and drying cycles (Marvin-DiPasquale et al. 2003). Black rail may be vulnerable to MeHg contamination because they reside in the Bay-Delta year-round. Black rails at north San Francisco Bay tidal marshes had lower MeHg concentrations than other waterbirds at San Francisco Bay (Ackerman et al. 2007, Tsao et al. 2009), likely due to their low-trophic-level invertebrate diet (Eddleman et al. 1994). The Proposed Action may affect MeHg production because a larger area of marshes would be exposed to slightly increased wetting and drying cycles. This potential change would be minor because of the relatively short duration of the change from current conditions.

Environmental Commitment BIO-6 requires the development of a monitoring plan to assess the sensitivity of black rail habitat to the hydrologic changes that would result from the Proposed Action, and the conservation of suitable habitat to compensate for adverse effects.

Other Raptors and Migratory Nesting Birds

Suitable nesting habitat for various raptors, as well as other migratory bird species, is present on or near the proposed Old River and Connection Slough sites. Numerous species have the potential to nest onsite, either in the marsh areas fringing the levees, or within trees, shrubs and grassland on the landward sides of the levees. These could include the including northern harrier, white-tailed kite, tricolored blackbird, loggerhead shrike, and other birds protected by the MBTA.

Construction activities could affect nesting behavior because land-based construction activities would occur during the nesting season. Removal of the gates and boat ramps between July and November would occur towards the end of or after the nesting season. Removal activities could adversely affect the nesting behavior of raptors or other protected species, if occupied nests are present. The new power poles installed for the Proposed Action would provide roosting habitat, which could result in accidental electrocution.

Environmental Commitment BIO-6 requires preconstruction surveys for nesting birds prior to construction activities and the implementation of avoidance or mitigation activities if active nests are present. These may include a no-disturbance buffer in which no new site disturbance is permitted until a qualified biologist determines that the young are foraging independently or the nest has failed. The power poles would include Raptor Protection measures, including the

installation of a deflector to prevent birds from roosting on the lines. Given the implementation of BIO-6, impacts to nesting birds from construction would be short-term and minor.

Proposed operations would not result in major impacts to protected bird species. A greater area of wetland and mudflat habitat along the levees and channel islands south of the gates would be exposed to foraging behavior during portions of March and June due to the stage changes discussed above. The increase in distance between dense vegetative cover and open water would increase the vulnerability of some juvenile shorebirds to predation. The area and density of wetland, riparian, and grassland habitat that provides nesting and foraging habitat for numerous species would not be affected by the change in stage due to the relatively short duration of operations and the modest magnitude of the effect on water surface elevation. Furthermore, the change in elevation would be within the existing range of tidal action, and marsh and shoreline species occurring in the affected environment are adapted to conditions in this zone of mixed hydrologic influences.

Nesting and foraging habitat for raptors and other migratory birds would not be affected by operation of the Proposed Action since operations are not expected to alter the amount or availability of habitat, and birds nesting in proximity to the gates would presumably be habituated to ongoing operations since operations would begin prior to the nesting season for all species of concern. Gates would be open during flood events, producing less than a 0.1-foot change in flood stage elevations in a 100-year event, so the disturbance of low-lying nesting habitat is unlikely.

Plants

Of the nine rare plants determined to have a potential to occur on the study area, seven are summer blooming plants, and one species, eel-grass pondweed, is distinguishable from other pondweed by its vegetative parts. A summer rare plant survey was conducted at the Old River site on September 23, 2008 and on the Bacon Island side of the Connection Slough site on September 29, 2008. A fall survey of the study area on Mandeville Island was conducted on October 6, 2009. A spring survey of the Old River and the Bacon side of the Connection Slough site was undertaken on June 24, 2009. Three rare plants were observed within the study area: brown fox sedge, woolly rose-mallow, and Suisun Marsh aster.

Individual special-status plants present within the development period of the Proposed Action could be negatively impacted by work conducted within this area. Environmental Commitment BIO-7 requires preconstruction surveys for rare plants and, avoidance or mitigation for rare plants, if present. The measure may also include the installation of orange construction fencing around the plants prior to site disturbance and ensuring that rare plants are not disturbed during construction. If areas cannot be surveyed during the appropriate season due to lack of access, a mitigation plan, approved by DFG, would be developed and implemented. Given the implementation of BIO-7, impacts to plants from construction would be short-term and minor.

No impacts would occur during operations because no new ground disturbance would occur.

Riparian and Wetland Habitats

Construction would occur within upland ruderal herbaceous, Coastal and Valley Freshwater Marsh wetland, and open water habitats only. Project designs specifically avoid mixed riparian

woodland and seasonal wetland habitats present on Holland Tract, Bacon Island, and Mandeville Island. Impacts to freshwater marsh wetland habitats on both sites have been minimized through the location and design of the Proposed Action. Impacts to wetlands would be limited to the area of fill from the boat ramps, and the installation of sheet piles perpendicular to the levees. Table 3.5-7 characterizes the area of wetlands, other waters, and non-jurisdictional ditches within the study areas defined for the Proposed Action and describes a minimum and maximum area of fill to waters of the U.S. that could occur as a result of the Proposed Action. The actual area of fill depends on the size of barge used for the gates. Construction of the Proposed Action would result in the temporal loss of 0.16 acre of freshwater marsh habitat due to the construction of the boat ramps and in-river sheet piles. Wetland habitat would be restored following the removal of the gate structures and boat ramps. Sensitive riparian and wetland habitats near the proposed site could be impacted through the inadvertent disturbance of adjacent areas outside the construction footprint during construction and removal.

Localized Hydrodynamic Effects

Impacts to wetlands could occur due to changes in hydrodynamics resulting from installation and operation of the gates. These are separated into two regions of influence. First, in the immediate vicinity of the gates, current velocity near the Old River and Connection Slough sites would be modified by the installation of the sheet piles and gates (see Section 3.9 and Appendix K). Model results indicate that the Proposed Action would not generally exceed erosion and deposition thresholds established for the delta (Appendix K). Both simulations provide data for surface water conditions on the ebb and flood tides during peak flows. At other times, velocities would be slower.

The Proposed Action's predicted slower water velocity in certain areas, coupled with wind conditions and growth patterns of floating weeds, could enhance the opportunity for exotic aquatic vegetation such as *Egeria*, water primrose, water hyacinth, or other floating debris to establish within obstructed flow areas. Growth of aquatic weeds is generally higher during the spring and summer, so this is when a larger accumulation of vegetation and debris would be expected to occur. At the 2-Gates sites, floating mats of aquatic weeds and floating debris would likely collect in the low velocity areas near the junction of the sheet pile wall and the levee, particularly on the east side of Old River. On the Connection Slough site, material would likely collect on the west side of the closed gate. These areas of floating debris and vegetation would be unlikely to impact the existing stands of emergent vegetation because they are not likely to invade areas of established emergent wetland which are present along the banks. Floating mats of vegetation such as water hyacinth can competitively exclude native submersed and floating-leaved plants (Washington Department of Ecology 2009). Gate operators would monitor the situation at each site and if floating weeds and debris become a problem for boat traffic, interfere with gate operations, or is determined to reduce local dissolved oxygen levels, a contractor would be called in to remove the material in an appropriate manner.

The volume of sediment that could accumulate in the slower velocity areas with the gates in place is not known. It is possible that sediments in slow velocity areas could accumulate to allow the establishment of small areas of emergent vegetation adjacent to existing freshwater marsh vegetation near the gates as well as the Old River channel islands. The likelihood that a significant amount of sediment would be deposited is low, because the system is generally

Table 3.5-5 Impacts to Potentially Jurisdictional Waters of the United States[1]				
Habitat	Location	Acreage	Approximate Area of Fill[2]	
			min	max
In-channel Freshwater Marsh (FM)				
	Connection Slough Study Area	2.23	0.06	0.06
	Old River Study Area	3.46	0.10	0.10
	FM Total	5.69	0.16	0.16
Other Waters (OW)				
	Connection Slough Study Area	10.83	1.10	1.32
	Old River Study Area	39.78	0.71	1.22
	OW Total	50.61	1.81	2.54
Seasonal Wetland (SW)				
	Connection Slough Study Area	0.5	0	0
	Old River Study Area	4.77	0	0
	SW Total	5.27	0	0
	Total Jurisdictional	62.25	1.97	2.70
Non-jurisdictional Irrigation/Drainage Ditches (D)[3]				
	Connection Slough Study Area	1.19	0	0
	Old River Study Area	0.14	0	0
	D Total	1.33	0	0
	Total Non-Jurisdictional	1.33	0	0

Notes:

1. A portion of the wetland area on Holland Tract was identified by aerial map interpretation. For mapped locations, see Appendix F.
2. The actual area of fill depends on the size of barge used for the gates. Permit applications for the minimum area of fill have been submitted to the USACE, DFG and RWQCB. "Fill" consists of barges, rock, sheet piles, boat ramps and floats, king piles and monopiles. Duration of fill discharge would be limited to the period of the demonstration project.
3. A jurisdictional determination (JD) by the Corps has not been conducted, so the wetland delineation is considered by the Corps to be "preliminary". The ditches are assumed to be non-jurisdictional because they are inundated through water siphoned from the rivers. A preliminary jurisdictional delineation by definition cannot be used to determine either that there are no wetlands or other water bodies on a site at all, or that there are no jurisdictional wetlands or other water bodies on a site, or that only a portion of the wetlands or water bodies on a site are jurisdictional (Corps 2008).

In-Channel Freshwater Marsh

In-channel freshwater marsh, totaling 5.69 acres, is present on the proposed site along Old River and Connection Slough between the mean watermark (MWM) and ordinary high-water mark (OHWM). A conservative average width of 6 feet of hydrophytic vegetation along all banks of the canal that did not contain riprap was used to calculate the total acreage of these wetland features on the proposed site. The hydrophytic vegetation along the canal is strongly associated with the small bench of substrate located between the MWM and OHWM. Dominant hydrophytic vegetation in the in-channel freshwater marsh includes Tule rush (*Shoenoplectus californicus*, OBL), bulrush (*Shoenoplectus acutus*, OBL), and common cattail (*Typha latifolia*, OBL).

Seasonal Wetland

Seasonal wetland, totaling 5.27 acres, was delineated on Bacon Island and Holland Tract. Indicators of wetland hydrology included inundation, sediment deposits, and drainage patterns in wetlands. Dominant vegetation in the seasonal wetland included Bermuda grass (*Cynodon dactylon*, FAC), umbrella sedge (*Cyperus eragrosits*, OBL), knotweed (*Polygonum arenastrum*, NL), and water smartweed (*Polygonum amphibium*, OBL).

Agricultural Ditches

Agricultural ditches, totaling 0.95 acres, were delineated on Bacon Island and estimated on Mandeville Island. Because the hydrology is provided by water siphoned from the rivers, we are assuming that the hydrology in these areas is artificial. Indicators of wetland hydrology included inundation, sediment deposits, and drainage patterns in wetlands.

sediment-starved, and the effects of the gates on hydrodynamics is modeled as small. Additionally, emergent vegetation establishes in areas with depths of -6 feet and higher, while the elevations adjacent to stands of emergent vegetation are around -18 feet. It is highly unlikely enough sediment would be deposited to create conditions conducive to the establishment of new areas of emergent vegetation.

Regional Hydrodynamic Effects

Changes in hydrology would also occur throughout the central and southern Delta. During March and June, the elevation of mean high water would be reduced upstream of the gates. The reduction would be relatively small, ranging from a reduction in mean high water in March from 13 inches at the Old River gate to 1 inch near Mossdale (see Figures 3.5-4 and 3.5-5, and Section 3.9 for details). In June, the reduction in mean high water would range from 11 inches at the Old River gate to 2 inches near Mossdale. Effects would generally be smaller in Middle River during both periods. Impacts would occur for 10 hours per day for a total 60 days, resulting in 600 hours of impact, or roughly 7 percent of the year. The effect of these changes on wetland vegetation upstream of the gates would likely be small. The reduction in water surface elevation would temporarily expose greater areas of mudflat habitats if present, but the short duration of the reduction would not likely result in the establishment of emergent vegetation within these mudflat areas. The surface area of wetlands affected by the reduction in average elevation would be relatively small on the levee sides due to the steep drop in elevation, while the surface area of wetland affected on the islands is likely to be larger due to the topography of the islands. Typical island topography is fairly flat, with elevations raging from 3 to 7 feet (NAVD), and the relatively small change in water surface elevation should not greatly affect the water availability to plants on the levees and islands due to the vegetation composition and soil characteristics.

North of the gates, operations would produce small increases in the elevation of mean high water, resulting in an increase in March and June of about 1 inch. This increase is not expected to result in a substantive impact on wetland vegetation, since it would occur over a short period of time.

The dominant vegetation in the channels is composed of tule rushes and cattails. These species are hardy colonizers, occurring in clonal stands and forming dense mats, reproducing rhizomatously (Esser 2005, Gucker 2008). The growing period for these perennial plants is long – most of the spring and summer – followed by senescence in the fall (USDA, NRCS 2009a and 2009b); flowering time for tule rush is June to September and for cattails is June to July (Hickman 1993). Shoots situated within upper elevations could become stressed by the lower water surface elevations during gate closure times. However, this stress would be mitigated by the deep roots that these plants typically form (at a minimum, 14 inches [USDA, NRCS 2009a and 2009b]). Another mitigating factor would be water availability via capillary action in the soils. Capillarity is usually highest in finer texture soils (loams, silt loams, clay loams) that are not too fine or compacted (e.g., compacted clay). In clay and loam soils, the distance of water availability can be in the range of roughly 30 and 80 cms from the water table (Brady and Weil 1996), making water available to roots above the water surface elevation. There is also a time component: the coarser the soils, the faster the rise (e.g., in a coarse-textured soil like sand, water would rise quickly by capillarity but not very high) (Brady and Weil 1996). The soils mapped in the study areas are generally finer textured (silt loams, clay loams, muck), which would indicate

a greater chance for capillary action within a moderate time period (like one month), especially on the channel islands where there is more soil than in the riprap levee sides, possibly counteracting any temporary drop in water level. The duration of the effect is a fraction of the growing season for these plants, and is not expected to greatly impact the growth or survival of existing stands, nor result in any long-term habitat shifts.

Seasonal Wetland

The seasonal wetland on Bacon Island near Connection Slough could be affected by the dredged materials in the disposal area. However the dredge disposal area would be surrounded by a berm that would prevent sedimentation and the discharge of runoff into the wetland feature from surface flows. In addition, an extensive suite of tests would be performed as required by CVRWQCB in support of obtaining the requisite water quality certification for disposal of the material at either Bacon Island or Roberts Island. These soil tests would compare sediments from Connection Slough and Old River to receiving areas, and include bulk sediment testing, a De-ionized Water-Waste Extraction Test, a Modified Elutriate Test, and a Dredging Elutriate Test. All testing would be performed prior to disposal and would include an assessment of the potential for metals to leach from the dredged materials above disposal site background levels. The results of this testing would be used to determine the suitability of the dredged material for disposal at either Bacon Island or Roberts Island. If the sediment were found to be unsuitable for disposal at these sites, it would be disposed of at another appropriate site, but this would be subject to separate environmental documentation.

Environmental Commitment BIO-8 requires the installation and weekly inspection of orange construction fencing around the perimeter of sensitive wetland and riparian habitats adjacent to the landward footprint of the proposed sites to prevent the movement of construction equipment into these sensitive areas during construction. Environmental Commitment BIO-9 requires restoration of wetland habitats following completion of the Proposed Action, and compensatory mitigation for the temporal loss of wetland functions and values. Given the implementation of BIO-8 and BIO-9, impacts to riparian and wetland habitats from construction would be short-term and minor.

Jurisdictional Waters of the U.S.

Implementation of the Proposed Action would result in the discharge of approximately 1.97 acres of fill into potentially jurisdictional waters of the U.S., including wetlands and other waters subject to Corps jurisdiction under the CWA, and Section 10 of the Rivers and Harbors Act. Construction of the pier-supported boat ramps and in-river sheet piles would require the discharge of fill to 0.16 acre of fill to Coastal and Valley Freshwater Marsh wetlands Construction of the gates would require the excavation of approximately 23,900 cubic yards of bed material in unvegetated waters of the U.S. and the discharge of approximately 29,700 cubic yards of fill, composed of bedding layers and rock fill over an area of 1.62 acres of fill in other waters of the U.S. Portions of the river beds (other waters) would be excavated and backfilled with rock to support the barges, and the barges would be secured to the riverbed. Seasonal wetlands in the laydown areas and in the spoil disposal area would be avoided. A berm would be constructed around the dredged materials disposal area to prevent runoff from the disposal site into the seasonal wetland and pertinent federal standards for the discharge of dredged material

would be observed. Impacts to wetlands and other waters have been minimized by the use of sheet piles rather than rock dikes to span the channels to the barges.

Environmental Commitment BIO-9 indicates that mitigation for the discharge of fill to wetland habitats would meet the requirements established by the Corps and RWQCB and may include a variety of measures, including the removal of the boat ramps and piers upon completion of the five-year demonstration period and the replanting of native plant materials to restore freshwater marsh vegetative habitat to the site; the purchase of wetland mitigation credit at an approved wetland mitigation bank or through the approval and implementation of a wetland mitigation and monitoring plan; and the installation of orange construction fencing around the perimeter of wetlands and other waters in proximity to construction activities to prevent accidental disturbance during construction. Given the implementation of BIO-8 and BIO-9, impacts to jurisdictional waters of the U.S. from construction would be temporary and minor.

Wildlife Movement

The Proposed Action would not interfere with the movement of terrestrial wildlife species or movement corridors once the construction activities are completed. Terrestrial special-status species with potential to occur within the area affected by the Proposed Action are highly mobile and would be able to move around the gates. Beavers, river otters, and muskrats are all semi-aquatic species that would be able to move around the gates during periods of closure. Periods of operation are expected to have minimal impacts on the movement of terrestrial wildlife.

3.6 Cultural Resources

3.6.1 Affected Environment

3.6.1.1 Cultural Overview

Archaeology and Regional Prehistory

Archaeological investigations in the Delta region began in the early 1890s with the excavations conducted by J. A. Barr and W. H. Holmes; the two amassed considerable collections of artifacts from mounds in the Stockton area, which were eventually donated to the U.S. National Museum (Moratto 1984:177). Found throughout the Delta, mound sites typically contain several strata of cultural deposits covering multiple millennia of occupation. Not surprisingly, early attempts to construct a chronology of the northern San Joaquin Valley were based on the excavations in the Delta region, most notably by Elmer J. Dawson. Dawson recognized cultural change in the strata at his mound site near Lodi and proposed a succession of periods (early, middle, and late) to categorize such change (Moratto 1984:177). Although the importance of his chronology was initially minimized by preeminent archaeologist W. E. Schenck, Dawson's sequence eventually was supported by studies in the Delta and lower Sacramento Valley during the 1930s.

The tripartite chronology has been reworked several times since Lillard, Heizer, and Fenenga (Moratto 1984) offered their sequence (Early, Transitional, and Late periods) for the Central Valley in the late 1930s. While subsequent chronologies have labeled the three eras differently, each time period does display a common suite of characteristics (Moratto 1984:180–214).

- Early Period/Early Horizon/Windmiller Pattern. Extended burials with westerly orientation are typically accompanied by funerary goods, including shell ornaments and beads. The high frequency of large projectile points indicates that subsistence centered on game. Grinding implements are present but infrequent.
- Transitional Period/Middle Horizon/Berkeley Pattern. Flexed burials with variable orientation are often accompanied by red ochre and sometimes by funerary items. There is a greater reliance on acorns, as suggested by the higher frequency of mortars and pestles compared to the previous period. Projectile points remain large, and bone tools are frequent and well developed.
- Late Period/Late Horizon/Augustine Pattern. Burials are typically flexed with a scarcity of grave artifacts. Subsistence continues to focus on acorns and other plant materials. Projectile points are smaller and marked with serrations. Shell beads and other ornaments are well developed, owing to an intensification of trade.

The above chronology helps consolidate a vast amount of data into a manageable number of time periods, but like any taxonomic division, it implicitly minimizes the importance of differences that exist within each time period and does not account for geographical variability. Such variation confounds attempts to devise an orderly chronology with absolute dates for each time interval. For instance, the earliest component of CA-SJO-68 contains mortars, pestles, and a bone awl (typically associated with the Berkeley Pattern), yet the site has been dated to around 4500 B.P., one of the earliest known sites in the Central Valley (Moratto 1984:207). In addition, radiocarbon dates from 31 central California sites indicate that the time ranges of the Windmiller, Berkeley, and Augustine patterns show considerable overlap, especially after 1750 B.P. (see Moratto 1984:200, Figure 5.11). The analysis suggests that the Windmiller and Berkeley Pattern sites in San Joaquin County (CA-SJO-145 and -91) were coeval with Augustine sites in Sacramento County between 1750 and 750 B.P. Moreover, consideration of geographical similarities and differences in the archaeological record of California indicates that the east-west flow of goods among the Bay, Delta, and Central Sierra regions was more pronounced than the economic ties between northern and southern valley peoples (Moratto 1984:215).

Habitation in the Central Valley predating the Early Period/Windmiller Pattern is evidenced by assemblages found near the Tulare and Buena Vista lakebeds as well as in the surrounding foothills and mountains. It is likely that most archaeological material in the Delta region dating to this early time is deeply buried under alluvium. Moratto (1984:214) observed that as much as 10 meters of sediments may have accumulated during the past 5,000 years.

Ethnography

The likely inhabitants in the vicinity of the Proposed Action were the Northern Valley Yokuts, whose territory extended south from Bear Creek near Stockton to the south side of the San Joaquin River past Mendota, east to the Sierra Foothills, and west to the Coast Range (Wallace 1978a:462). Specifically, the *Chulamni* tribe occupied the area west of present-day Stockton. Given the fluidity of tribal borders, however, it is possible that the Plains Miwok, located north of the Yokuts, also used the area. Wallace (1978a:462) subsumes the *Chulamni* into the Northern Valley Yokuts but acknowledges that others have considered the tribe as Plains Miwok.

Pettigrew et al. (1994:3 34–3 35) note that the Northern Valley Yokuts occupied year round villages along the San Joaquin River and other major tributaries to exploit riverine resources. The Delta wetlands stocked an array of waterfowl and aquatic resources as well as herds of browsing mammals that frequented the fringes of the marshes. Wallace (1978a:464) states that fish were one of the most important resources procured, with salmon topping the list of preferred varieties. Like all California peoples, prehistoric inhabitants of the Delta also depended on acorns and other plant foods.

The Northern Valley Yokuts were organized into individual autonomous villages composed of single-family structures (Moratto 1988:174). The structures were small and usually built from woven tule mats. Other structures included sweathouses and ceremonial chambers. Villages were established on high ground near drainages and other valley water sources (Moratto 1988:174).

Most stone artifacts were fashioned of chert from nearby coastal sources, and obsidian was imported from other locations (Wallace 1978a:465). Mortars and pestles were the dominant ground stone tools; bone was used to manufacture awls for making coiled baskets. Tule was important in the manufacture of mats and boats, and other materials were acquired by trading with neighboring Miwok and Coastanoans.

As with other Indian groups in the valley, the lifeways of the Northern Valley Yokuts were dramatically altered as a result of contact with Spanish explorers and missionaries, miners, ranchers, and other European immigrants who entered the valley after 1800. Population estimates for the eighteenth century put the number of Yokuts living in the San Joaquin Valley at around 41,000. However, the introduction of European culture and Old World diseases proved devastating to the native population. Traditional lifestyles were diminished and numerous people died from epidemics (Moratto 1988:174).

3.6.1.2 History

Early Exploration and Settlement

The first recorded European encounter with the Yokuts occurred in 1772 when Spanish explorer Pedro Fages led a group of soldiers through Tejon Pass into the San Joaquin Valley (Wallace 1978b:459). During the late 1700s, the Spanish established a string of missions along the California coast. Although initially insulated from the direct impact of the missions, the Northern Valley Yokuts no doubt had some contact with the Spanish. Mission San Jose was founded in 1797, effectively establishing a Spanish presence along the Northern Valley Yokuts' western border. Gabriel Moraga and his band entered the valley in 1806 to locate new lands for missions, find and return runaway Indians, and relocate stolen livestock (Clough and Secrest 1984:25–27). Moraga is credited with naming several valley geographical features, including the San Joaquin and Stanislaus rivers. Although Mexico's independence from Spain ended expansion of the missions in California by the early 1820s, European encroachment on the areas occupied by the indigenous peoples continued. In the late 1820s, fur trappers began their forays into the California interior. Jedediah S. Smith passed through the area during a fur trapping expedition in 1827, and French Canadian trappers of the Hudson's Bay Company established a seasonal base at French Camp just south of present-day Stockton (Shideler 1988:1).

Although relatively short lived, California's Mexican administration (1821–1848) facilitated the economic transition between Spanish mercantilism and Euro-American capitalism. The Colonization Act of 1824 and the Supplemental Regulations of 1828 afforded private individuals—both Mexican nationals and immigrants—the right to obtain title to land (Hackel 1998:132). In 1834, the missions were secularized, effectively freeing up their enormous landholdings to private interest. From this point until California's accession into the Union, the Mexican authorities made over 800 land grants, often designated as "ranchos," to individuals with the intent to settle and improve these parcels (Monroy 1998:180).

In 1844, the government granted William Gulnac, a native of New York, the Campo de los Franceses, a nearly 49,000 acre tract that included French Camp (Smith 2004:148–152). One year later, Gulnac, who was unable to permanently settle on the land, sold the property to Captain Charles H. Weber in exchange for his $60 grocery bill owed at Weber's store in San Jose. Weber, a German immigrant, went on to establish the town of Stockton in 1849. Smith's (2004:158) map of Mexican land grants indicates that the sites included in the Proposed Action were not part of any rancho; prior to the mid 1800s, the marshlands west of Stockton were unsuitable for ranching or agriculture.

The gold rush triggered a mass immigration to California. Stockton, which could be reached via steamboat from San Francisco, served as the port of entry to the gold fields east of the town. As the gold fervor subsided, former miners looked to other pursuits, and Stockton became an important shipping center for wheat, cattle, dairy products, and other goods.

Farming and Development of the Delta

Early attempts by farmers in the 1850s to reclaim the swamplands west of town confirmed the fertility of the soil, but their makeshift levees were largely ineffectual during times of flood (Lortie 1996:4; Maniery 1993:7). Large-scale, long-term reclamation required a capital investment beyond the means of individual landowners. Taking advantage of a series of federal and state reclamation acts, wealthy investors from San Francisco purchased large tracts of swampland at cheap prices with the intent to reclaim them for agricultural purposes. These landowners included George T. Roberts (Roberts Island), Henry Bacon (Bacon Island), James Haggin (Staten Island), T. H. Williams (Victoria Island), and the Sargent brothers (Bouldin and King islands) (Maniery 1993:7). Horse-drawn scrapers were used to build levees and dredge waterways, and much of the labor was provided by former rail workers. Many of these Chinese laborers were then retained to till the newly reclaimed soil. Construction proceeded on a trial-and-error basis, and the first levees often could not protect the reclaimed "islands" (which lay below sea level) during times of flood. By the late 1870s, engineering methods had improved, and reclamation efforts apparently reached at least a moderate level of success. In 1879, Thompson and West acknowledged past difficulties while foreseeing a promising outlook for the reclamation of the Delta: "The results already achieved from the unportentous beginning have been great. What the future may have in store is not hidden behind a shadow, yet its extent is incalculable" (Gilbert 1968:42).

Beginning in the 1890s, however, cracks began to develop not only in the original land monopoly of San Francisco investors but also in the levees themselves. The initial levees made from peat soil were subject to sinking and fracture, and the high waters of winter and spring caused breaches around many of the islands (Maniery 1993:9). Continual repair and maintenance

costs led many original landowners to sell their properties. Some of these transactions involved the transfer of title from one San Francisco investor to another, although by the 1910s and 1920s the property in the Delta was being sold or leased in smaller parcels to a larger number of individual farming operations (Lortie 1996:7, Maniery 1993). The introduction of such heavy machinery as the clamshell dredge spurred the construction of new levees and facilitated the maintenance of existing ones; peat was replaced with more stable sediment dredged from river bottoms (PAR Environmental Services 1996:9). Most notably, the California Delta Farms Company, established by Lee Philips in 1907, reclaimed vast acreage for lease to farmers, including George Shima, who raised predominantly potato crops on Bacon, McDonald, and other Delta islands (Maniery 1993:11).

Before the turn of the century, the only means to transport harvested crops off the Delta islands was via boat. Farming operations included landings to assist the loading of cargo onto ships headed for markets in Stockton, Sacramento, and San Francisco (PAR Environmental Services 1996:10–11). The arrival of the railroad in 1900 and the construction of roads and bridges in the 1910s made the region more accessible, which not only reduced freight costs but increased the value of the Delta land.

Small communities arose at or near the convergence of these transportation routes in the vicinity of the Proposed Action. Located along the waterway known as the Middle River with access to the Atchison, Topeka and Santa Fe Railway, the town of Middle River served as an important shipping point and the site of an asparagus cannery as early as 1915 (Hillman and Covello 1985:217–218). Similarly, the town of Holt lay at the intersection of the southern end of Whiskey Slough, the Santa Fe tracks, and the Delta Borden Highway (the precursor of SR 4). Completed in 1915, the highway was the first paved roadway through the Delta and included a series of swing bridges spanning the numerous waterways of the marshlands. Located a few miles upstream from the town of Middle River, the Middle River Bridge (P 39 000474) was built in 1915 as part of this early transportation network; it remains today as a historically and architecturally significant structure (California Department of Transportation 1990:116).

In addition to its importance as a transportation center for agricultural and dairying interests, Holt became the focus of social activity in the Delta (Hillman and Covello 1985:211–214). The town's saloons, a blacksmith, general stores, and other commercial businesses attracted farmworkers from the surrounding areas. A 1910 map shows a spur of the Santa Fe tracks leading to a cannery located along Whiskey Slough, and a 1917 photo depicts multistory restaurants and hotels (Hillman and Covello 1985:212, 214). Continual improvement in transportation networks ironically led to Holt's demise, as local residents found it easier to drive to nearby Stockton. The highway has since been rerouted 0.5 mile south of its original path, and presently little remains of Holt except for a marina on Whiskey Slough and a nearby post office that still bears the town's name.

While engineering methods and technology have come a long way since the mid and late 1800s, rising river levels still pose a very real threat to the levee system. In 1983, waters broke through around nearby Mildred Island; the area has remained submerged. In spring 2004, a breach occurred at the southwest corner of the Upper Jones Tract. The levee has since been repaired, and currently most of the water has been drained from the area.

George Shima—the "Potato King"

Typical of most Central Valley areas, the infusion of immigrant manpower and vision has been integral to the development and modernization of the agriculture industry in the California Delta region. Holt housed an ethnic collage of farmworkers, including Chinese, Portuguese, Italian, and Mexican immigrants (Hillman and Covello 1985:214). In particular, Japanese were the primary work force in the Delta from the early twentieth century until their internment in detention camps during World War II. For most first generation Japanese immigrants, however, farm labor was not an end in itself but the first step in securing a better life for the worker and his family.

Like Kyutaro Abiko, who established the Yamato Colony in Merced County, George Shima (Kinji Ushijima) came to California from Japan with more aspirations than capital. After laboring in the potato fields, he had saved enough money to lease his own plot in 1893 (Maniery 1993:11). For about a decade, Shima endured economic and natural hardships, often relying upon loans from friends to stave off bankruptcy. In 1902, he teamed with Lee Philips.

Usually, Philips acquired ownership to land, built levees and ditches, and secured an island. He then leased it to Shima, usually under an oral agreement and a hand shake. Shima then provided labor and equipment to burn off vegetation, prepare the land for planting, and farm (Maniery 1993:12).

By 1906, luck and market conditions had finally swung Shima's way. He produced more than 3 million bags of potatoes on 8,000 acres of leased land, which gave one newspaper reason to dub him the "Potato King" (Maniery 1993:12–13). In 1907, Shima recorded a substantial profit when the price of potatoes soared due to shortages in the market.

Up until 1910, Shima cultivated leased land exclusively. While ownership of an agricultural parcel is perhaps more profitable over the long haul, the lessee of land does enjoy certain benefits: he is not saddled with property costs such as levee maintenance and can devote more of his finances to farming operations since less money is tied up in property investments. In this way, Shima was able to leverage his resources to control thousands of acres of farmland. The lease arrangement with Philips and his California Delta Farms Company worked especially well for Shima, who was able to maintain a constant turnover of land by leasing newly reclaimed areas and terminating the leases on older parcels. Long before the introduction of modern fertilizers, Shima considered that a plot was no longer suitable for potato crops after 3 years of cultivation (Maniery 1993:12). As his empire grew, the Potato King sought to invest his profits in property; he bought an 800 acre farm in 1910 and added another 800 acre lot the following year. In 1913, however, passage of the California Alien Act prohibited the purchase of land by a noncitizen, although Shima and other Japanese could indirectly acquire land through their U.S. born children (Maniery 1993:14). In addition to the lands he leased from the California Delta Farms Company, Shima maintained his own property and leased other plots to individual farmers.

In 1916, Shima leased 5,600 acres on Bacon Island, which had been reclaimed by the California Delta Farms Company the year before (Maniery 1993:15). In general, the management of such vast acreage was structured into camps, each headed by a foreman who oversaw the cultivation of 100 to 500 acres (Maniery 1993:20–22). Located near the waterways, these camps typically

contained a foreman's house, cookhouse, and one or more boarding houses; larger camps included other ancillary structures such as a blacksmith or machine shop. Camps housed from 20 to 50 men in small units to as many as 350 to 400 in larger complexes. Based on the size and number of structures, Camp No. 3 (CA-SJO-213H)—south of the Old River site on Bacon Island—typifies one of the larger complexes, whereas Camp No. 4 (CA-SJO-214H), adjacent to the Old River, appears to be one of the smaller settlements.

3.6.1.3 Historic and Prehistoric Resources at the Proposed Sites

Methods

Records Searches and Background Research

Records searches for the Connection Slough and Old River APEs were completed by the Central California Information Center at California State University, Stanislaus on September 10, 2008 and by the Northwest Information Center at Sonoma State University on October 3 and 13, 2008. A records search at the Central California Information Center at California State University, Stanislaus was completed for the Roberts Island #1 disposal site (Figures 2-2 and 3.6-2) on September 2, 2009. Site record files, maps, and other materials were examined to identify previously recorded cultural resources (e.g., prehistoric sites, historic sites, historic buildings/structures, and isolated artifacts) and prior surveys conducted within the proposed sites. Sources consulted also included the Historic Property Data File, the National Register of Historic Places, the California Register of Historical Resources, the listings of California Historical Landmarks, the California Inventory of Historic Resources, and the California Points of Historical Interest. The records searches identified the following information regarding the Old River, Connection Slough, Roberts Island #1 disposal sites (Figure 3.6-1 and 3.6-2).

Old River

The Old River APE consists of an area approximately 600 feet long and 140 feet wide on either side of Old River and an approximately 900 foot long by 275 foot wide corridor across the channel (Figure 3.6-3). The area across the channel includes the sites for the cargo barges, pilings, and boat ramps that would be located in the channel. The APE was previously surveyed. Greenway and Soule (1977) surveyed the Holland Island portion of the Old River APE and Maniery et al. (1989) surveyed the Bacon Island and Holland Island portion of the Old River site for the Delta Wetlands Project. Maniery et al. (1989) identified site CA-SJO-214H, Shima Camp No. 4, near, but beyond the Old River APE. Maniery et al. (1989) also identified the Old River site as being within the Bacon Island Rural Historic District. Maniery determined that the Bacon Island Rural Historic District was eligible for inclusion in the National Register of Historic Places (NRHP), but the Office of Historic Preservation has not reviewed and concurred with this determination. In addition, the Holland Tract levee, which was built in 1910, is within the Old River APE. The Historic Property Data File identifies this levee as not eligible for inclusion in the NRHP.

Connection Slough

The APE for the Connection Slough Area consists of an area approximately 600 feet long and 140 feet wide on either side of Connection Slough, an approximately 3-acre dredged materials disposal area on the northeast corner of Bacon Island, and an approximately 400 foot long by

400 foot wide corridor across the channel (Figure 3.6-4 and Figure 2-10 [Bacon Island disposal area]). The area across the channel includes the sites for the cargo barges, pilings, and boat ramps that would be located in the channel. The Mandeville Island portion of the APE has not been previously surveyed, but the APE on Bacon Island was previously surveyed by Maniery et al. (1989) for the Delta Wetlands Project. Subsequent documentation relating to that project included Maniery's (1993) NRHP evaluation of the Bacon Island Rural Historic District and Jones & Stokes' (1995) executive summary of the Draft Environmental Impact Report (EIR). These investigations did not identify any cultural resources in the Connection Slough APE, but the section of Bacon Island within the Connection Slough APE is within the boundaries of the Bacon Island Rural Historic District (Maniery 1993: Figure 26). Maniery determined that the Bacon Island Rural Historic District was eligible for inclusion in the NRHP, but the Office of Historic Preservation has not reviewed and concurred with this determination.

Roberts Island #1 Disposal Site

The APE for the Roberts Island #1 disposal site consists of an approximately 250-acre area adjacent to a levee along the San Joaquin River (Figure 3.6-2). Previous survey of this APE did not identify any cultural resources (Port of Stockton 2003). The APE also is currently used for the disposal of dredged materials.

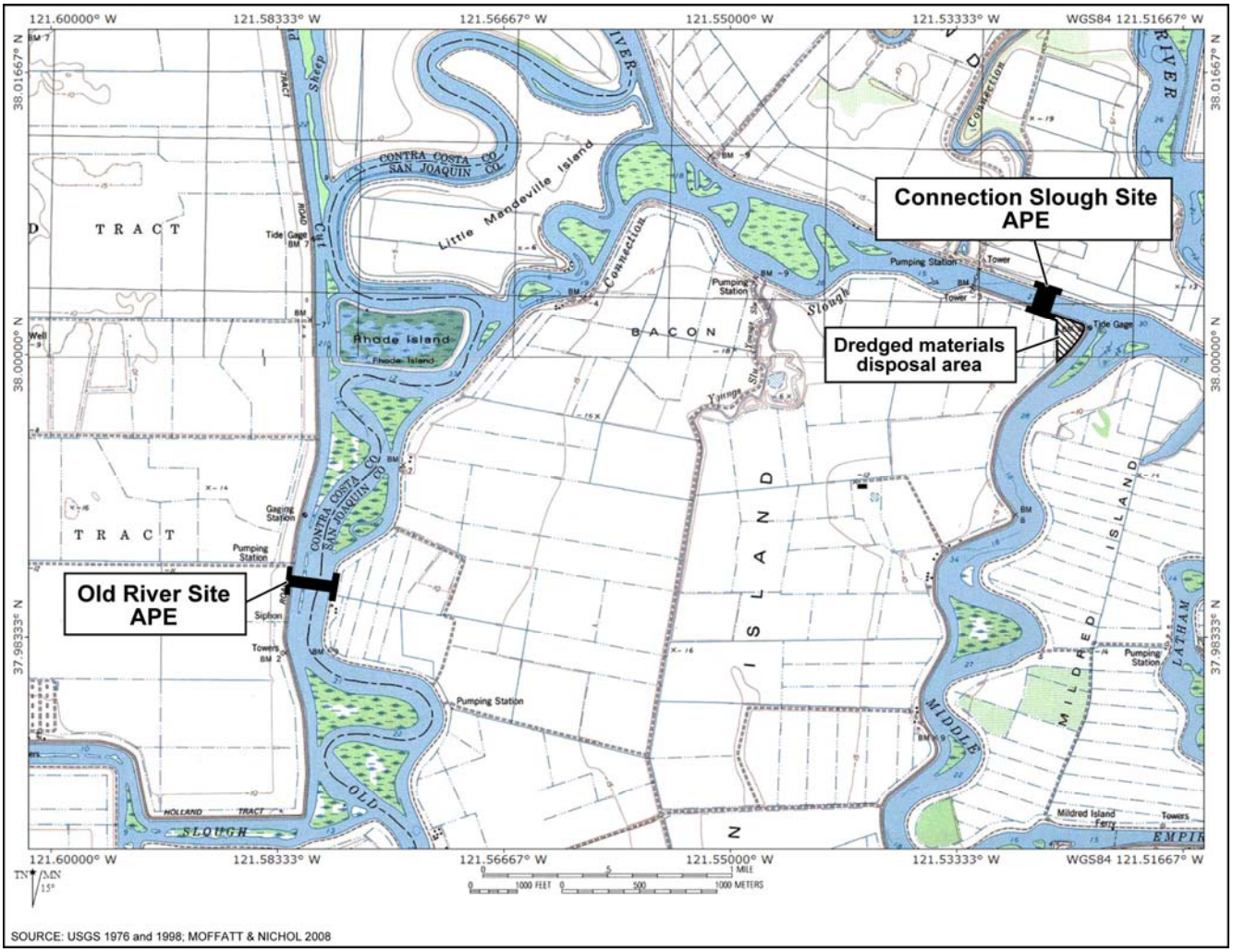


Figure 3.6-1 Location of the Areas of Potential Effect for Old River and Connection Slough Sites

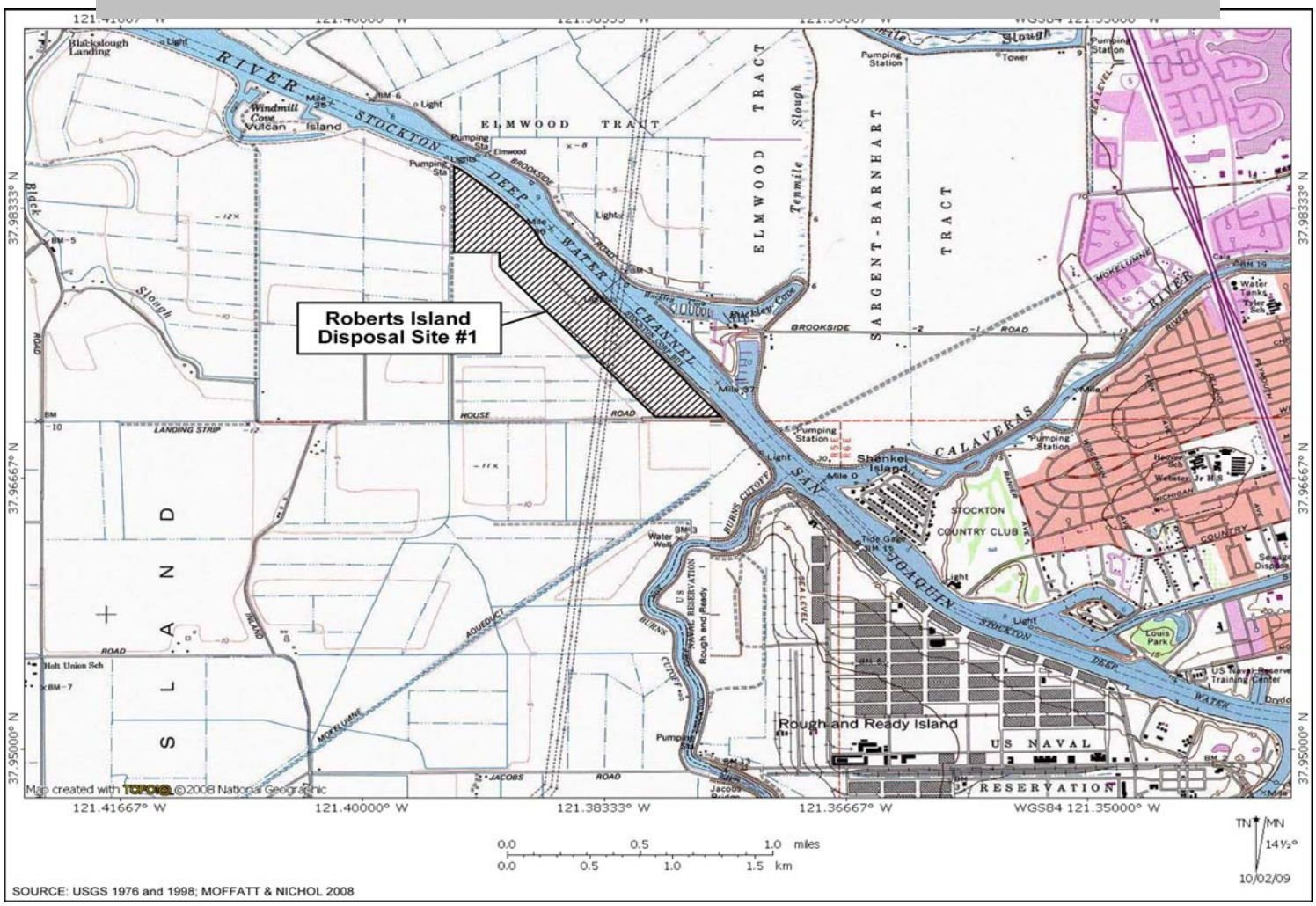


Figure 3.6-2 Roberts Island #1 Disposal Site Area of Potential Effects

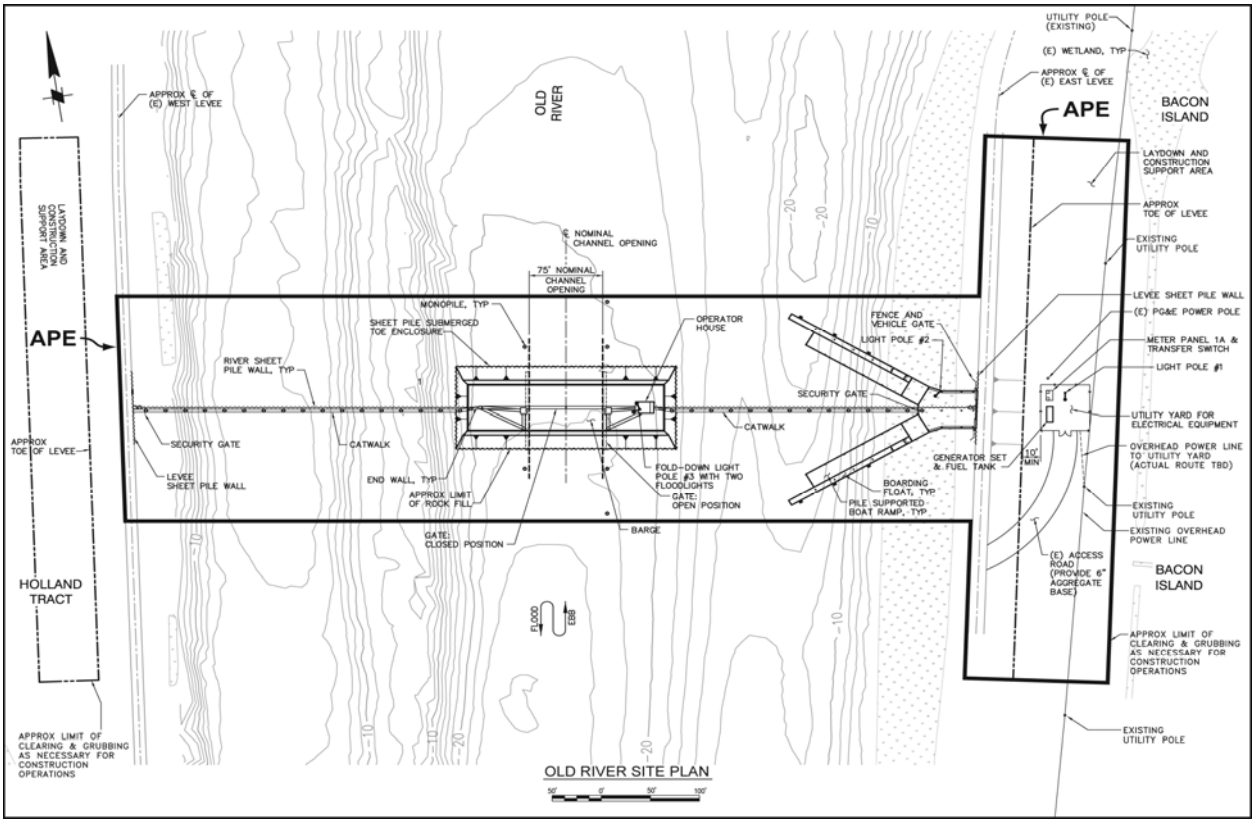


Figure 3.6-3 Old River Site Plan View and Area of Potential Effects

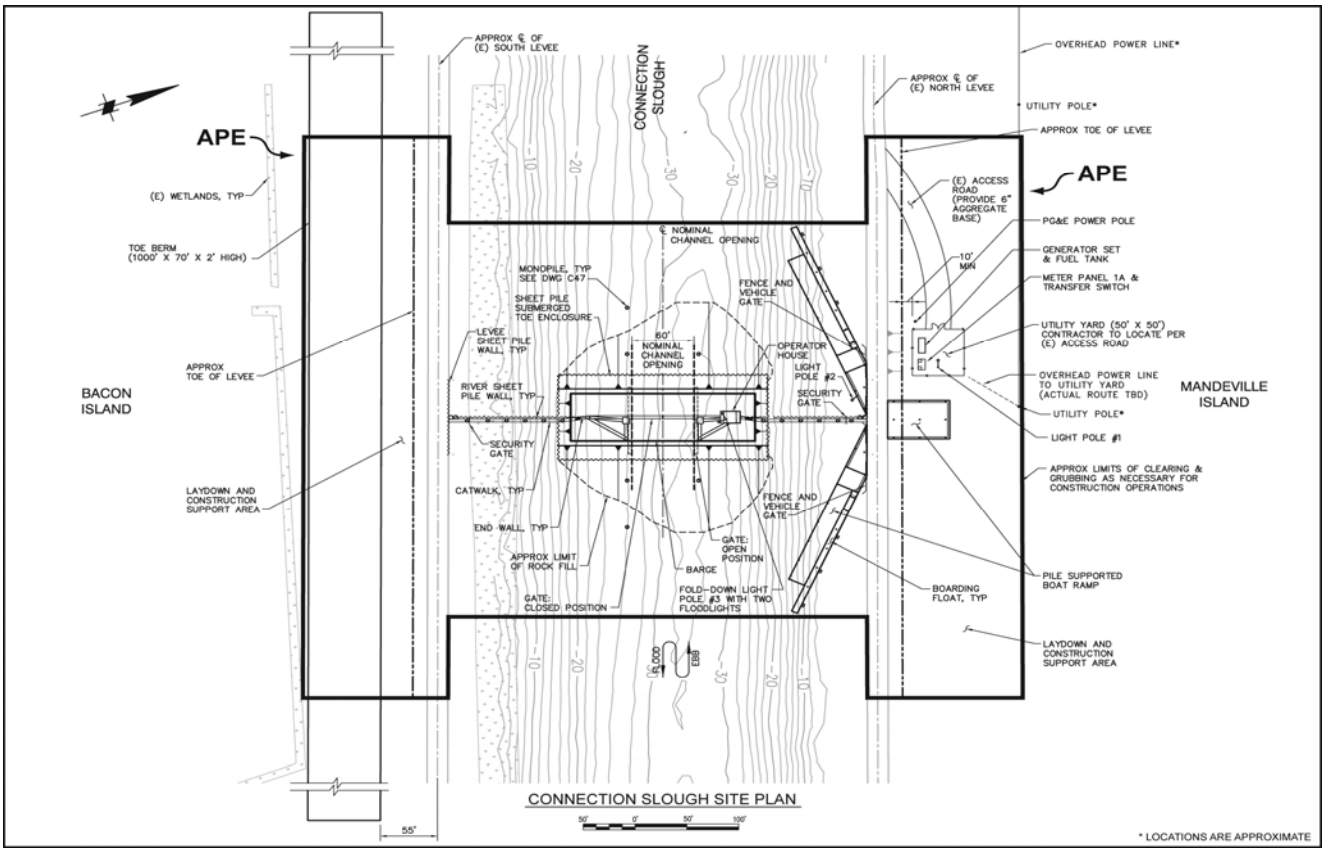


Figure 3.6-4 Connection Slough Site Plan View and Area of Potential Effects

Native American Consultation

Applied Earthworks (Æ) contacted the Native American Heritage Commission (NAHC) to request a search of its sacred lands file for the area affected by the Proposed Action and the names and contact information of groups and/or individuals that could provide information relevant to this area. Æ contacted the groups and individuals identified by the NAHC by mail regarding the Proposed Action and solicited information regarding the proposed sites and surrounding area and the location of any sensitive Native American cultural resources within it. Æ also contacted all groups and individuals that were sent letters by telephone to confirm that the correspondence was received and to provide an opportunity for comment. The only comment from the Native American community regarding the Proposed Action was sent by the Ione Band of Miwok Indians, indicating that the Proposed Action is outside of their Ancestral Territory.

Reclamation as federal lead agency conducted Native American consultation to comply with their Section 106 responsibilities related to the Proposed Action. Reclamation contacted the Wilton Rancheria and the California Valley Miwok Tribe pursuant to 36 CFR Part 800.3(f) (2) and Part 800.4(a) (4) to inquire as to the potential presence of any sites of religious or cultural significance within the APE for the Proposed Action. Reclamation has not received any responses from the Tribes.

Survey

Æ archaeologist Randy Baloian performed a pedestrian surface survey of the Bacon Island portion of the Connection Slough APE and the entire Old River APE (Figure 3.6-1) on October 2, 2008. The survey consisted of systematic transects spaced at 15 to 20 meter intervals across the proposed sites. ENTRIX archaeologist John A. Nadolski performed a pedestrian surface survey of the Mandeville Island portion of the Connection Slough APE on October 3, 2009. The survey consisted of systematic transects spaced at 10 meter intervals across the proposed site. The following identifies the surface visibility, survey coverage, and survey results for each of the proposed areas.

Connection Slough APE

The entire Connection Slough APE was surveyed. The Bacon Island portion of the APE was surveyed. Surface visibility on Bacon Island was generally good (75 to 100 percent) along the levee road but decreased to 10 to 50 percent on the slope and level terrain below the crest of the levee. Survey coverage was confined to the areas immediately adjacent to the road by a corn field with dense vegetation that completely obscured ground visibility. No cultural resources were observed in the Bacon Island portion of the Connection Slough APE.

Surface visibility on Mandeville Island was generally good (75 to 100 percent) along the levee road, but decreased to 50 percent on the slope and level terrain at the base of the levee. No cultural resources were observed in the Mandeville Island portion of the Connection Slough APE.

Old River APE

The entire Old River APE was surveyed. A large part of the Bacon Island portion of the Old River APE is recently graded, facilitating good to excellent surface visibility (90 to 100 percent). Survey coverage was limited to the areas immediately adjacent to the road by a dense corn field

that completely obscured ground visibility. No cultural resources were observed in the Bacon Island portion of the Old River APE.

In the Holland Tract portion of the Old River APE, a short but dense blanket of grass covers the shoulders along the levee road. The vegetation becomes increasingly taller and thicker with greater distance from the road. Surface visibility ranged from 10 to 75 percent in this area. No cultural resources were observed in the Holland Tract portion of the Old River APE.

Roberts Island Disposal Site #1

The Roberts Island Disposal Site #1 APE was completely surveyed for use as a dredge materials disposal site as part of a Port of Stockton project at Rough and Ready Island (Port of Stockton 2003). Currently, the APE is graded, covered with dredged materials, and surrounded by a dirt berm.

3.6.2 Regulatory Setting

3.6.2.1 National Historic Preservation Act of 1966

The National Historic Preservation Act (NHPA) of 1966 established the federal historic preservation program and made it the policy of the federal government, in partnership with the states, local governments, Indian tribes, and private organizations and individuals, to preserve, protect, and manage cultural resources for "the inspiration and benefit of present and future generations" (16 U.S.C. 470-1, Section 2[3]).

Section 106 of the NHPA directs federal agencies to take into account the effects of their actions on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment with respect to the effects of the undertaking. Implementing regulations for Section 106 are found at 36 CFR Part 800, and establish the procedures federal agencies must follow when assessing the effects of a proposed action on historic properties. The term "historic properties" is defined at 36 CFR 800.16(l)(1) as "….any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the [NRHP]…[and] includes properties of traditional religious importance to an Indian tribe or Native Hawaiian organization that meet the National Register criteria."

To be eligible for listing on the NRHP, a cultural resource must be at least 50 years old (although there are exceptions) and must meet one or more of the eligibility criteria set forth at 36 CFR 60.4 which state:

> The quality of significance in American history, architecture, archaeology, engineering and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or (b) that are associated with the lives of persons that are significant in our past; or (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic value, or that represent a significant and distinguishable entity whose components may lack

> individual distinction; or (d) that have yielded, or may likely yield, information important in prehistory or history.

Cultural resources are evaluated for potential listing on the NRHP with reference to an historic context and associated research questions, in consultation with the State Historic Preservation Officer and/or Tribal Historic Preservation Officer, tribes, and other interested organizations and individuals.

3.6.2.2 Executive Order 13007

Pursuant to Executive Order (EO) 13007 agencies must also consider the effects of their actions on the physical integrity of sacred sites, and access to and ceremonial use of such sites by Indian religious practitioners. EO 13007 defines a "sacred site" as:

> …any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site.

EO 13007 directs federal agencies "…to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions," to accommodate access to and use of such sites by Native American traditional religious practitioners, and to avoid affecting their physical integrity.

3.6.2.3 Resolution of Effects

Following 36 CFR 800.4, 800.5 and 800.6, Reclamation shall identify historic properties within the APE of an undertaking and apply the criteria of adverse effects to any historic properties within a project's APE. If the results of the assessment of effects identify that a project would likely result in "No Adverse Effect," Reclamation shall follow guidance at 36 CFR 800.5 (d) (1). If the results of the assessment of effects identify that a project would likely result in an "Adverse Effect" Reclamation shall follow guidance at 36 CFR 800.5 (d) (2) and continue to consult with the State Historic Preservation Officer, Native American groups, and other interested publics to resolve the adverse effect pursuant to 36 CFR 800.6.

3.6.3 Environmental Consequences

The impact analysis presented in this section addresses the regulatory requirements of NEPA and Section 106 of the NHPA.

3.6.3.1 No Action Alternative

No impacts to cultural resources would occur because the Proposed Action would not be implemented.

3.6.3.2 Proposed Action

Cultural Resources

There are no archaeological sites or historic buildings/structures within the boundaries of the Old River and Connection Slough APEs, but the APEs of the two project sites are within the Bacon Island Rural Historic District. The Bacon Island Rural Historic District appears to be eligible for inclusion in the NRHP. Regardless, implementation of the Proposed Action would not directly affect any historic sites within the district, nor would it affect the integrity or any other characteristics of the district that make it eligible for inclusion in the NRHP. The Proposed Action would not affect the Bacon Island Rural Historic District because it would primarily be constructed in waterways bordered by levees at the edges of the district and would not introduce any elements into the areas surrounding the levees that would compromise the setting, feeling, or association of the district. In addition, the Proposed Action is being constructed for demonstration purposes and would be deconstructed upon completion of data collection. There are no archaeological sites or historic buildings/structures within the boundaries of the Roberts Island #1 disposal site, and it has been previously used for the disposal of dredge materials; therefore, no impacts to cultural resources would result from its use.

The levees in the Old River and Connection Slough APEs are approximately 100 years old. These eligibility of these levees for inclusion in the NRHP has not been determined. For purposes of this analysis, however, they are conservatively assumed to be eligible. Implementation of the Proposed Action would require minor modifications to the levees that include the installation of sheet pile and boat ramps (Figure 2-9). These modifications would not alter the overall design or function of the levees. Therefore, the Proposed Action would have a minor impact on the levees under NEPA and a "No Adverse Effect" for purposes of Section 106.

Unanticipated Discoveries of Cultural Resources

No archaeological sites or historic buildings/structures were identified within the Proposed Action APE. There is a possibility, however, of unanticipated and accidental archaeological discoveries during implementation of ground-disturbing activities associated with the Proposed Action. Ground disturbing project activity could have a substantial impact on inadvertently discovered cultural resources.

Environmental Commitment CR-1 addresses the unanticipated and accidental discovery of cultural resources during implementation of the Proposed Action. If any prehistoric or historic artifacts, or other indications of archaeological resources are discovered once project construction is underway, the discoveries shall be considered pursuant to the Section 106 process presented at 36 CFR Part 800.13. Subsequent to implementation of CR-1, any impacts to inadvertently discovered cultural resources during implementation of the Proposed Action would be minor.

Unanticipated Discoveries of Human Remains

No human remains or evidence to suggest that human remains may be present were identified within the APE during cultural resources investigations for the Proposed Action. There is a possibility, however, of the unanticipated and accidental discovery of human remains during implementation of ground-disturbing activities.

Environmental Commitment CR-2 addresses the unanticipated and accidental discovery of human remains during implementation of the Proposed Action. If human remains are discovered

once project construction is underway, all work would be halted immediately within 50 feet of the discovery and the discovery would be considered pursuant to Section 7050.5 of California's Health and Safety Code and the Section 106 process presented at 36 CFR Part 800.13. Subsequent to implementation of CR-2, any impacts to inadvertently discover human remains during implementation of the Proposed Action would be minor.

3.7 Geology and Soils

3.7.1 Affected Environment

3.7.1.1 Overview

Both the Old River and Connection Slough sites are located in Holocene-age (10,000 years B.P. to present day) alluvial fan deposits and dune sands. These deposits extend up to 30 feet below ground surface where they are underlain by older, late-Pleistocene (10,000 to 70,000 years B.P.) alluvial fan deposits and stream terrace deposits (Helley and Graymer 1997, Kashiwagi and Hokholt 1991). These sedimentary deposits are characterized by soft, water-saturated muds, peat, and loose sands. Local areas may slump and slide. Muds contain expansive clays, and the area is considered to have a high liquefaction potential. The surrounding areas are reclaimed wetlands, which experience amplified lateral and vertical movements that can be damaging to structures. The 2-Gates area also is subject to subsidence, the gradual setting or sinking of the earth's surface with little or not horizontal motion. Subsidence results from the oxidation of peat on the Delta islands, as well as such factors as anaerobic decomposition, shrinkage, wind erosion, and compaction by farm equipment (Contra Costa County 2005, San Joaquin County 1992). The Roberts Island #1 disposal site is an existing facility, and the disposal of dredged material from the Proposed Action at this site would neither affect nor be affected by geological resources, and the use of this site is not discussed further.

Seismic hazards are those hazards associated with earthquakes. None of the proposed sites is in a mapped Alquist-Priolo Special Studies Zone[3] (Contra Costa County 2005, San Joaquin County 1992, CGS 2006). The active seismic source closest to the project sites is the Midland fault, a thrust fault located approximately 3 miles west of the Old River site. The many active faults in the region include the Tracy-Stockton, Patterson, Calaveras, Hayward, and San Andreas faults (Contra Costa County 2005 and San Joaquin County 1992).

3.7.1.2 Old River Site – Subsurface Conditions

Subsurface exploration completed for the Old River site includes two borings in fields on Holland Tract west of the levee, three borings on the crest, one near the landside toe, and two in the fields beyond the landside toe of the Bacon Island levee. At the Holland Tract side of the Old River channel, the native peat and organic soil extend to about elevation -18 feet in the two borings drilled in the fields west of the levee. Exploration data further north and south of the planned Holland Tract abutment suggests that the base of the peat and organic soil may be near elevation -22 feet. The peat and organic soil is underlain by sand that extends to about elevation -

[3] Under the Alquist-Priolo Earthquake Fault Zoning Act, the State of California defines an active fault as one that exhibits evidence that surface rupture has occurred within the last 11,000 years (i.e., Holocene activity). Under the Act, the state has identified active faults within California and has delineated "earthquake fault zones" along active faults. This act restricts development of structures for human habitation within the earthquake fault zones to reduce the potential for injuries and damage caused by fault rupture.

60 feet. For preliminary design, the tule berm is assumed to be composed of peat and organic soil with sand lying below elevation -18 feet. The original channel of Old River is assumed to be a layer of silt or silty sand overlying sand. As the channel becomes shallower approaching the Bacon Island levee, the soils above elevation -15 feet are assumed to be peat and organic soil, with sand below that elevation. At the Bacon Island side of the Old River channel, the peat extends down to about elevation -12 feet and is underlain by sand.

3.7.1.3 Connection Slough Site – Subsurface Conditions

Subsurface exploration completed to date for the Connection Slough site includes four borings on the levee crest, one boring near the landside levee toe, two borings in the Bacon Island fields south of the landside levee, and three borings within the southern portion of Connection Slough. Peat and organic soil, together with an underlying 5-foot-thick layer of normally consolidated elastic silt, extend to about elevation -30 to -35 feet in the borings drilled on the Bacon Island levee and in Connection Slough. These soils are underlain by 5 to 10 feet of medium dense sand over 5 to 8 feet of stiff clay. Below the stiff clay are thicker deposits of sands interbedded with silt and clay to the depths explored.

3.7.2 Regulatory Setting

No federal regulations related to geology and soils are applicable to the Proposed Action. Both the San Joaquin County General Plan (San Joaquin County 1992) and the Contra Costa County General Plan (Contra Costa County 2005) contain policies intended to prevent adverse impacts associated with geology and soils.

3.7.3 Environmental Consequences

3.7.3.1 No Action Alternative

The No Action alternative would not affect geology and soils because no development would occur.

3.7.3.2 Proposed Action

Geotechnical investigation have been performed at the Old River site and the Connection Slough site (Bacon Island side only; Mandeville Island side is pending). These consisted of explorative land-based borings and monitoring wells at each levee abutment and explorative borings beneath the waterway gate structure from a barge. The borings explored the thickness and strength of the underlying fill and peat layer, and the thickness, permeability and relative density of the sand formation underlying the peat soil. Monitoring wells along the existing levees were used to verify the existing groundwater elevations in the sand formations. The field data were used to refine the design criteria and recommendations for final design and construction, including site-specific levee improvements.

The Old River and Connection Slough sites are located in an area that contains expansive soils and is subject to lateral spreading, subsidence, and liquefaction. The design would comply with the recommendations included in the pre-design and design-level geotechnical engineering investigation reports intended to avoid impacts associated with unstable geologic units and soils.

Surface ground rupture along faults is generally limited to a linear zone a few yards wide. No active faults are mapped across the proposed sites by the California Geological Survey or the

USGS, and because they are not located in an Alquist-Priolo Earthquake Special Study Zone, fault ground rupture is unlikely (San Joaquin County 1992, Contra Costa County 2005, CGS 2008).

The Old River and Connection Slough sites are located in modern sediments of the Delta lowlands, are located near seismically active areas, and are highly susceptible to damage from ground shaking and liquefaction (Contra Costa County 2005). Most likely sources of strong ground shaking include the San Andreas, Hayward-Rodgers Creek, Calaveras, Green Valley-Concord, Greenville, Great Valley, and Tracy-Stockton faults. The current State of California earthquake forecast strategy is based on the concept that earthquake probabilities change over time. The 2007 Working Group on California Earthquake Probabilities (2008) produced the Uniform California Earthquake Rupture Forecast, Version 2, or "UCERF." Based on most recent calculations, three of these faults have been determined to have a relatively high probability for one or more earthquakes with a magnitude greater than or equal to 6.7 to occur within the next 30 years. These are the Hayward-Rodgers Creek fault (31 percent probability), Northern San Andreas (21 percent probability) and the Calaveras (7 percent probability) (2007 Working Group on California Earthquake Probabilities 2008). Thus, the gate foundations would be subject to seismic ground shaking associated with a Modified Mercalli Intensity level VII (defined as Very Strong).

Ground motions from seismic activity can be estimated by probabilistic method at specified hazard levels. The intensity of ground shaking depends on the distance from the earthquake epicenter to the site, the magnitude of the earthquake, site soil conditions, and the characteristic of the source. Data contained in the Probabilistic Seismic Hazard Assessment for the State of California Model, 2002 (USGS/CGS 2003), suggest there is a 10 percent probability that the peak horizontal acceleration experienced at the site would range from 0.275g for firm rock to 0.332g for alluvium (where "g" is the acceleration of gravity) in 50 years. According to the California Building Code (CBC) (2001 edition), the site is located in Seismic Zone 4, which implies a minimum horizontal acceleration of 0.4g for use in earthquake-resistant design. The CBC specifies more stringent design guidelines where a project would be located adjacent to a Class A or B fault as designated by the California Probabilistic Seismic Hazard Maps (USGS/CGS 2003). Hayward-Rodgers fault is a Class A fault (Cao et al. 2003). Although the facilities could be subject to strong seismic ground shaking, the Proposed Action would be required to adhere to the building safety standards specified in the CBC for Seismic Zone 4, which include measures designed to prevent significant structural damage from seismic ground acceleration.

Project site soil types include interlayered deposits of loose to dense silty to clayey sands mixed with stiff clays. These factors, combined with a high probability for strong seismic ground shaking, indicate that proposed facilities could be subject to liquefaction. The Proposed Action would be designed in accordance with the recommendations presented in both the predesign and design-level geotechnical engineering investigation reports and would comply with the CBC requirements. Additionally, all earthwork would be monitored by a geotechnical engineer tasked with the responsibility of providing oversight during all excavation, placement of fill, and disposal of materials removed from and deposited on the project sites. Because these features would be incorporated into the project design, this impact is considered minor.

Although the Old River and Connection Slough sites are located in an area of relatively flat topography, they are located in a tidal area, thus exposing site soils to the potential for wind erosion. Construction activities would involve some excavating, moving, filling, and temporary stockpiling of soil onsite. Grading activities would remove any vegetative cover and expose site soils to erosion via wind and surface water runoff. The Proposed Action would be required to implement BMPs as part of its SWPPP, which would prevent substantial soil erosion or the loss of topsoil. Environmental Commitment HYDRO-1 also would require the implementation of r***emedial actions should observable sediment transport be detected in the Old River and Connection Slough channels.*** Additional detail regarding erosion and sedimentation is included in Section 4.9, Hydrology and Water Quality.

The following standard erosion and sediment control measures and practices would be used during and after construction to ensure that impacts from soil erosion and sedimentation are minimal:

- Minimize site disturbance
- Perform initial cleanup
- Compact subsurface backfill material
- Leave topsoil in roughened condition
- Construct water bars
- Perform seeding and mulching
- Install erosion control blankets
- Install silt fencing and straw bale dikes
- Conduct daily inspections and periodic maintenance of erosion and sediment control measures

3.8 Hazards and Hazardous Materials

3.8.1 Affected Environment

The Old River and Connection Slough sites are located in rural area where the primary source of contaminants is pesticides and fertilizers used for agricultural operations. Neither site is listed on the California Department of Toxic Substances Control's (DTSC) Hazardous Waste and Substances Sites List (also known as the Cortese List) (DTSC 2009). There are no Superfund National Priorities List (NPL) sites within 5 miles of these sites (EPA 2008). The Roberts Island # 1 disposal site is an existing facility and does not contain hazardous materials. All sediment is tested for physical and chemical characteristics in accordance with CVRWQCB requirements (2004) in order to ensure that it is suitable for placement in this upland disposal site.

The Proposed Action area contains peat soils. Once ignited, peat fires pose a special hazard because they are very difficult to extinguish. In some cases, islands have been flooded to extinguish peat fires, although even flooding may not always put out the fires (San Joaquin

County 1992). The Old River site is classified as having over 9.5 days per year of Critical Fire Weather (Contra Costa County 2005), the highest classification in the county.

3.8.2 Regulatory Setting

3.8.2.1 Clean Water Act

The Spill Prevention Control and Countermeasures requirements (Title 40 CFR Part 112) were developed pursuant to the Clean Water Act. Spill Prevention Control and Countermeasures are intended to reduce the threat of spills of hydrocarbons to navigable waters of the United States.

3.8.2.2 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (42 U.S.C. Section 6922) (RCRA) establishes requirements for the management of hazardous wastes from the time of generation to the point of ultimate treatment or disposal. 42 U.S.C. Section 6922 requires generators of hazardous waste to comply with record keeping requirements relating to the identification of quantities of hazardous wastes generated and their disposition, labeling practices and use of appropriate containers, use of a manifest system for transportation, and submission of periodic reports to the EPA or authorized state.

3.8.2.3 Title 40, Code of Federal Regulations, Part 260

These regulations were promulgated by the EPA to implement the requirements of RCRA as described above. The regulations define the characteristics of hazardous waste in terms of ignitability, corrosivity, reactivity, and toxicity and list specific types of wastes deemed hazardous.

3.8.2.4 Hazardous Materials

Title 22 of the CCR, Division 4.5, Chapter 11 contains regulations for the classification of hazardous wastes. A waste is considered a hazardous waste if it is toxic (causes human health effects), ignitable (has the ability to burn), corrosive (causes severe burns or damage to materials), or reactive (causes explosions or generates toxic gases) in accordance with the criteria established in Article 3 Characteristics of Hazardous Waste. Article 4 lists specific hazardous wastes, and Article 5 identifies specific waste categories, including RCRA hazardous wastes, non-RCRA hazardous wastes, extremely hazardous wastes, and special wastes.

3.8.2.5 Worker Safety

Occupational safety standards exist in federal and state laws to minimize worker safety risks from both physical and chemical hazards in the workplace. The California Occupational Safety and Health Administration is responsible for developing and enforcing workplace safety standards and assuring worker safety in the handling and use of hazardous materials.

3.8.2.6 Wildland Fire

The California Public Resources Code includes fire safety regulations that: restrict the use of equipment that may produce a spark, flame, or fire; require the use of spark arrestors on construction equipment that has an internal combustion engine; specify requirements for the safe use of gasoline-powered tools in fire hazard areas; and specify fire suppression equipment that must be provided onsite for various types of work in fire-prone areas.

3.8.2.7 Local General Plans

Both the Contra Costa County (2005) and San Joaquin County (1992) General Plans contain general goals and policies intended to protect public safety.

3.8.3 Environmental Consequences

3.8.3.1 No Action Alternative

The No Action alternative would not affect hazards or hazardous materials because no development would occur.

3.8.3.2 Proposed Action

Construction

Commonly used hazardous materials would be used during construction (e.g., fuels, lubricants). All materials would be handled in accordance with regulatory requirements intended to prevent significant hazards to workers, the public, and the environment.

During construction, heavy equipment and vehicles would be present at the project sites. All contractors would be required to adhere to mandatory federal Occupational Safety and Health Administration regulations. Most of this equipment requires a number of petroleum products such as fuel, hydraulic fluids, and lubricants for effective operation. Lubricant and hydraulic fluid changes and replenishment would be required less frequently. Typically, service trucks deliver these types of fluids to the site and then perform the necessary fuel and oil transfers. The risk of small fuel or oil spills is considered possible, but this would have a negligible impact on public health. Any spills would be cleaned up in accordance with permit conditions, as outlined in Section 2. During non-working hours, heavy equipment and vehicles in areas that could be accessed by the public would be secured in a general contractor's staging area that would not pose a safety hazard.

Most construction would occur in the water, and thus would not pose a fire hazard. Some construction activities would occur in the laydown areas. The fuel tanks on board some construction equipment can contain fuel volumes ranging from 100 to 500 gallons. Accidental ignition could result in a fire, which, depending on the location, could spread. Moreover, given the peat soils, a fire could be difficult to contain because peat fires burn below the ground surface. All construction vehicles and equipment are required by Contra Costa and San Joaquin counties to have fire suppression equipment on board, or they are required to be otherwise present at the work site. They also are required to ensure the availability of an adequate on-site supply of water with all-weather access for fire-fighting equipment and emergency vehicles. Therefore, adherence to Contra Costa and San Joaquin County codes and requirements during construction would reduce the potential for fires.

Operations

Diesel would be required to power the generators during operations until power was obtained from the PG&E grid, and diesel generators would be used as an emergency source of power. During construction, all materials would be handled in accordance with regulatory requirements intended to prevent significant hazards to workers, the public, and the environment.

Signage at the gates would comply with navigation requirements established by the U.S. Aids to Navigation System and the California Waterway Marker system as appropriate. A boat safety exclusion zone would be established to keep boats clear of the closed gates in case gates begin to open, both to avoid gate swing and potential rapid changes in water velocity. The safety exclusion zone also is intended to keep boats clear of the upstream side of the barrier during floods when the barrier is spilling and boats could be swept over the barrier. Channel markers also would be installed to indicate that the center opening (between the gate pivot posts) is the only navigable opening in the structure, and the side openings are not to be used. The gates also would be lit at night, as would the channels leading to the gates. These provisions would minimize the potential for hazards to boaters, including water skiers, wakeboarders, and those using personal watercraft, by providing a notification of the gates' presence, guidance for the appropriate means of transiting the gates, and by providing a safety exclusion zone intended to keep boaters away from the gates during potentially unsafe conditions.

During floods, the gates would be in an open position. The catwalk and operations house would remain above water during such times (Figure 2-17), and navigational aides (buoys, markers, lights), including those marking the safety exclusion zone, would remain visible. Thus, the structures would not pose undue hazards during floods should boaters be on the water at such time.

3.9 Hydrology and Water Quality

3.9.1 Affected Environment

3.9.1.1 Surface Water Hydrology

The San Joaquin River originates in the Sierra Nevada Mountains and flows west to the Central Valley. It meets the Sacramento River near the city of Antioch, and together they form the Sacramento-San Joaquin Delta, one of the largest estuaries in the United States. Two distributary rivers, the Old River and the Middle River, flow from the San Joaquin River before it joins the Sacramento River; both of these once were the main channels of the river. Because of the bend in the San Joaquin River channel at the head of the Old River, a substantial portion of the San Joaquin River flow continues down the Old River instead of heading northward along the main stem of the San Joaquin. Flows along the Old River are eventually divided between the Old River, Middle River, and Grant Line Canal. In response to concerns about impacts to outmigrating salmon resulting from lower flows in these areas, DWR and DFG have, in the past, installed temporary rock barriers and have recently proposed other barrier technologies[4] at the head of the Old River in order to keep fish in the main channel of the San Joaquin River in the spring.

The hydrology of the Delta can be characterized by the speed that water moves (velocity), the amount of water that is conveyed or moved by the tides (conveyance or flow, in terms of cubic feet per second [cfs]) and the height or depth of the water (stage or water surface elevation). The remainder of this section describes these parameters (velocity, flow, and stage) for the waters of the Delta under current operations

[4]DWR 2009b: http://www.water.ca.gov/news/newsreleases/2009/051309bubblecurtain.doc

Surface water in the Delta is dominated by tidal flows from San Francisco and Suisun bays and runoff from upstream in the Sacramento and San Joaquin River watersheds. Average daily inflow (and outflow) of water from tidal action is approximately 170,000 cfs. The average estimated freshwater outflow from the combined watershed is approximately 30,000 cfs (DWR 1993). Approximately 77 percent of the freshwater inflow is derived from the Sacramento River portion of the watershed. The main stem and tributaries of the San Joaquin River contribute about 15 percent of the total freshwater inflow, and streams that flow directly into the Delta (e.g., the Mokelumne River) contribute the remainder of the freshwater.

Surface water flow in Old River and Connection Slough is dominated by natural tidal variations and is also affected by diversion pumping at the CVP and SWP export pumping facilities and other in-Delta exporters. The California Data Exchange Center (CDEC) installs, maintains, and operates an extensive hydrologic data collection network include a suite of hydrologic data collections stations in the Delta. The USGS also maintains a set of stream gages in the Delta. Table 3.9-1 displays the peak total flow at selected locations in the Delta for the months of January and February. This table includes both historic and simulated flows to account for the changes in operations for compliance with the recent CVP/SWP Operations BOs (USFWS 2008b, NMFS 2009a). Table 3.9-2 displays the peak total flow at selected locations in the Delta for the months of March and June. This table includes both historic and simulated flows to account for the changes in operations. These results were obtained through the use of the RMA-Delta Model (Appendix A).

Table 3.9-1 Simulated (2004) Peak Total Flow in January and February at Selected Sites in the Delta

		Current Peak Total Flow (cfs) during January-February 2004			
		Ebb Tide		Flood Tide	
		January	February	January	February
Station Name	Code				
Chipps Island		442,671	456,090	-386,759	-369,202
False River	FAL	56,240	54,715	-60,552	-62,003
Sacramento River @ Freeport	FPT	61,877	75,071	17,507	15,921
Grant Line Canal	GLC	6,361	6,213	-5,345	-5,012
Old River at Holland Cut	HOL	29,612	29,112	-31,728	-33,618
Jersey Point	JPT	159,472	157,996	-161,246	-157,081
Middle River S of Woodward Cut	MID	6,741	7,051	-9,438	-9,353
Mokelumne River @ SJR	MOK	21,488	22,563	-13,091	-12,799
Mossdale	RSAN087	2,929	4,455	-148	-101
Middle River @ Medford Island	MRC	31,292	30,612	-37,843	-38,881
Old River @ Bacon Island	ROLD024	13,498	13,580	-16,856	-16,487
Old River W of Victoria Island	ROLD034	7,995	8,643	-11,761	-11,690

Table 3.9-1 Simulated (2004) Peak Total Flow in January and February at Selected Sites in the Delta

		Current Peak Total Flow (cfs) during January-February 2004			
		Ebb Tide		Flood Tide	
		January	February	January	February
Station Name	Code				
Old River @ San Joaquin River	OSJ	11,390	10,662	-13,509	-15,867
Prisoners Point	PRI	63,899	62,101	-75,408	-79,676
Rio Vista	RSAC101	143,270	197,193	-102,473	-100,547
Middle River @ Middle River	RMID015	12,485	12,816	-16,977	-16,989
Cache Slough @ Ryer Island	RYI	97,616	140,896	-96,081	-91,321
San Andreas	SAN	118,980	115,539	-125,249	-124,856
Threemile Slough	SLTRM004	27,568	27,220	-36,818	-40,107
Turner Cut	TRC	2,256	2,227	-3,319	-3,189
Victoria Canal	VIC	3,359	3,736	-5,556	-5,585

Table 3.9-2 Simulated (2004) Peak Total Flow in March and June at Selected Sites in the Delta

		Peak Total Flow (cfs) for March and June 2004							
		Ebb Tide				Flood Tide			
		March		June		March		June	
Station Name	Code	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Chipps Island		425,783	424,951	443,911	441,965	-409,224	-410,782	-369,456	-373,235
False River	FAL	55,846	55,754	52,949	52,427	-61,621	-61,964	-59,915	-60,662
Sacramento River @ Freeport	FPT	19,652	19,668	72,797	72,796	5,195	5,196	23,305	23,297
Grant Line Canal	GLC	6,030	5,902	6,320	6,597	-4,275	-4,645	-4,082	-4,206
Old River at Holland Cut	HOL	30,785	30,446	27,800	26,935	-32,293	-32,606	-31,637	-32,476
Jersey Point	JPT	157,777	157,393	153,504	151,907	-165,173	-166,119	-156,824	-158,917
Middle River S of Woodward Cut	MID	6,001	5,672	6,818	6,141	-9,954	-9,973	-8,538	-9,643
Mokelumne River @ SJR	MOK	17,608	17,622	21,066	21,053	-14,098	-14,014	-11,649	-11,448
Mossdale	RSAN 087	2,127	2,106	4,681	4,653	-289	-174	1,968	2,007

Table 3.9-2 Simulated (2004) Peak Total Flow in March and June at Selected Sites in the Delta

		Peak Total Flow (cfs) for March and June 2004							
		Ebb Tide				Flood Tide			
		March		June		March		June	
Station Name	Code	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Middle River @ Medford Island	MRC	31,681	31,471	29,865	29,056	-38,649	-39,149	-37,556	-38,578
Old River @ Bacon Island	ROLD 024	13,616	13,428	13,254	12,541	-17,172	-17,628	-15,759	-16,740
Old River W of Victoria Island	ROLD 034	6,981	6,384	8,342	7,331	-12,730	-13,294	-10,496	-13,150
Old River @ San Joaquin River	OSJ	12,178	12,089	10,738	10,516	-13,698	-13,856	-13,979	-14,473
Prisoners Point	PRI	63,752	63,508	60,957	59,954	-75,810	-76,659	-78,691	-80,261
Rio Vista	RSAC 101	123,000	123,250	190,228	190,444	-117,176	-117,278	-94,199	-94,149
Middle River @ Middle River	RMID0 15	12,094	11,825	12,562	11,593	-17,765	-18,260	-15,980	-17,398
Cache Slough @ Ryer Island	RYI	91,733	91,983	134,237	134,420	-95,054	-95,086	-93,606	-93,478
San Andreas	SAN	118,136	117,805	115,083	113,631	-127,245	-128,071	-124,296	-126,708
Threemile Slough	SLTR M004	28,298	28,204	25,701	25,277	-34,411	-34,666	-37,641	-38,246
Turner Cut	TRC	2,640	2,586	2,127	1,910	-3,758	-3,805	-3,276	-3,558
Victoria Canal	VIC	2,908	2,616	3,620	3,133	-6,172	-6,815	-5,036	-6,908

Surface water flow near the Old River and Connection Slough sites also is dominated by natural tidal variations and diversion pumping at the various export pumping facilities. As a result of the channel size, configuration, and location of Connection Slough, flow rates at this site are substantially lower than at the Old River site. Figure 3.9-1 shows the peak water velocity on a flood tide in the Old River channel with current conditions. Peak flows rates of approximately 2 to 2.5 feet per second (ft/sec) occur near the downstream end of the in-channel island at its easterly turn for the oxbow north of Rock Slough Holland Cut and within the extension of the Holland Cut on the westerly side of the in-channel island. Similarly, Figure 3.9-2 shows the peak water velocity on an ebb tide in the Old River channel with current conditions. Peak flows at a rate of approximately 1.5 to 2 ft/sec occur in various sections of the channel.

Figures 3.9-3 through 3.9-10 display the range of simulated net flows for current operations at selected locations in the Delta. The month of January was selected a representative of winter conditions in the Delta. These figures include both the modeled flow under historic and simulated current operational flows based on a common hydrologic condition of tide and

watershed inflow. Both conditions are provided to describe the hydrologic conditions that have been found in the Delta (historic) and those that would be expected under typical hydrologic conditions with current operations for compliance with the recent CVP/SWP Operations BOs (USFWS 2008b, NMFS 2009a). Likewise, Figures 3.9-11 through 3.9-18 display the range of modeled net flow from actual conditions and for current operations at selected locations in the Delta. The month of March was selected as representative of spring and early summer conditions in the Delta. These results were obtained through the use of the RMA-Delta Model (Appendix A).

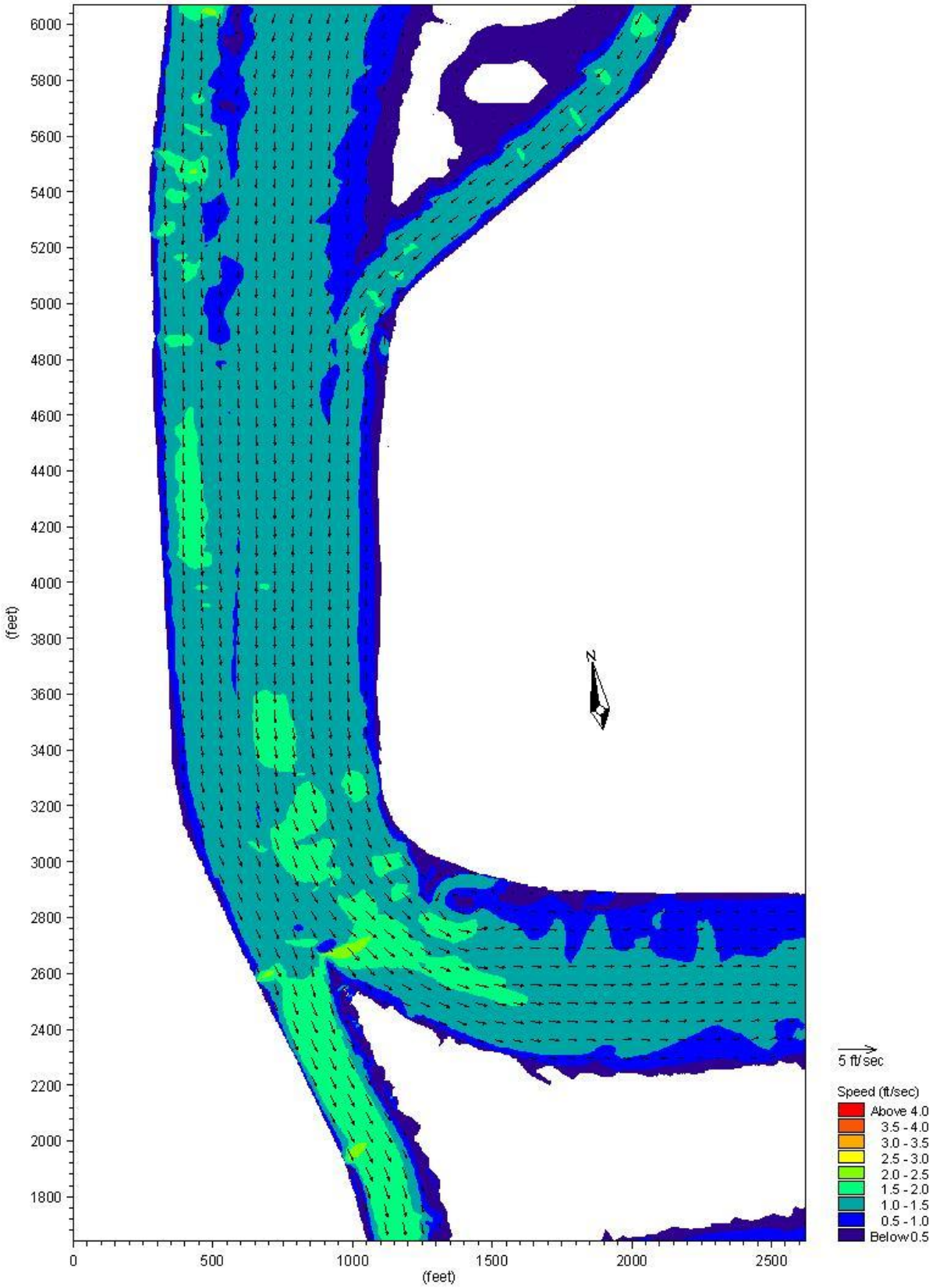


Figure 3.9-1 Peak Flood Tide Existing Velocity

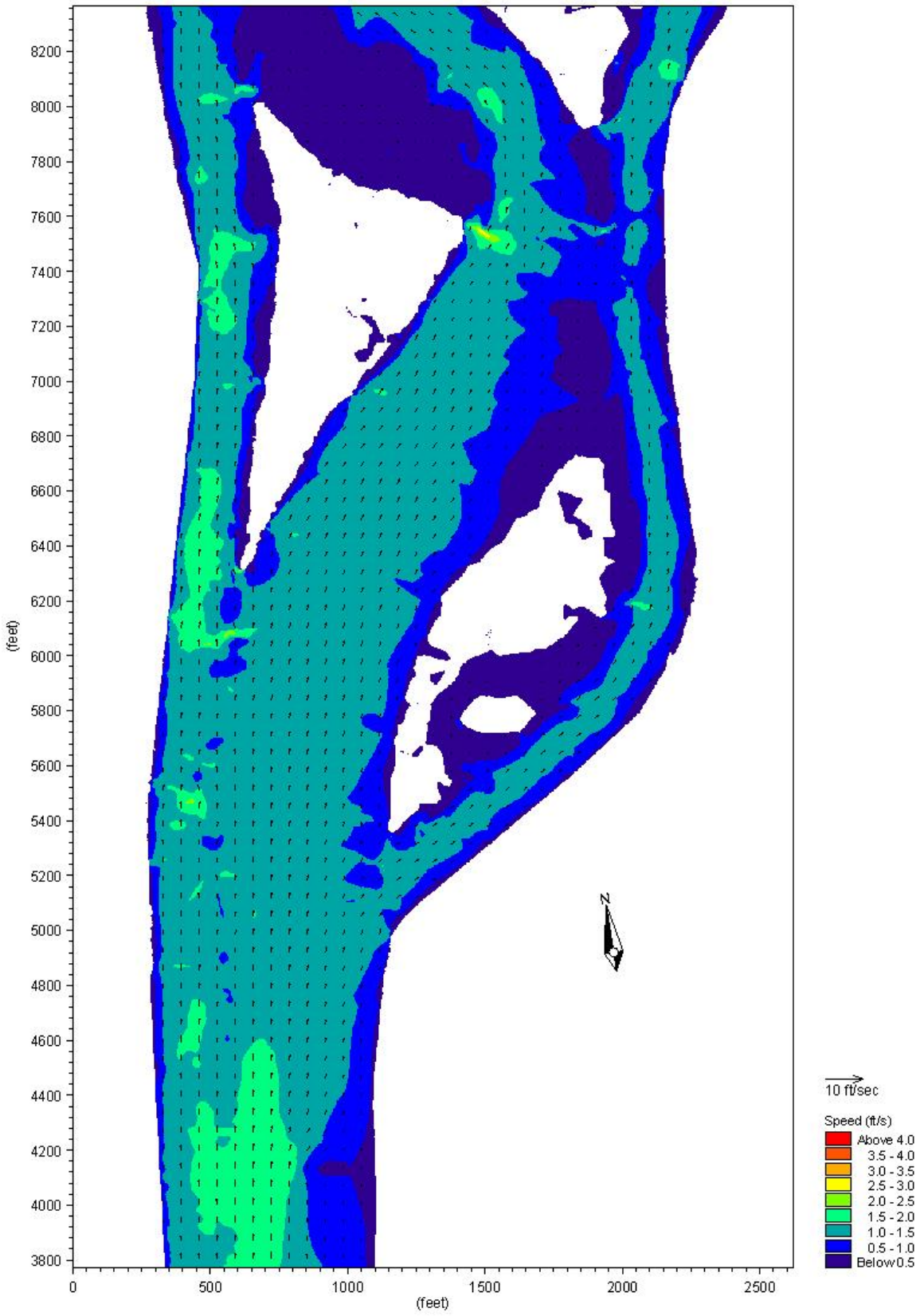


Figure 3.9-2 Peak Ebb Tide Existing Velocity

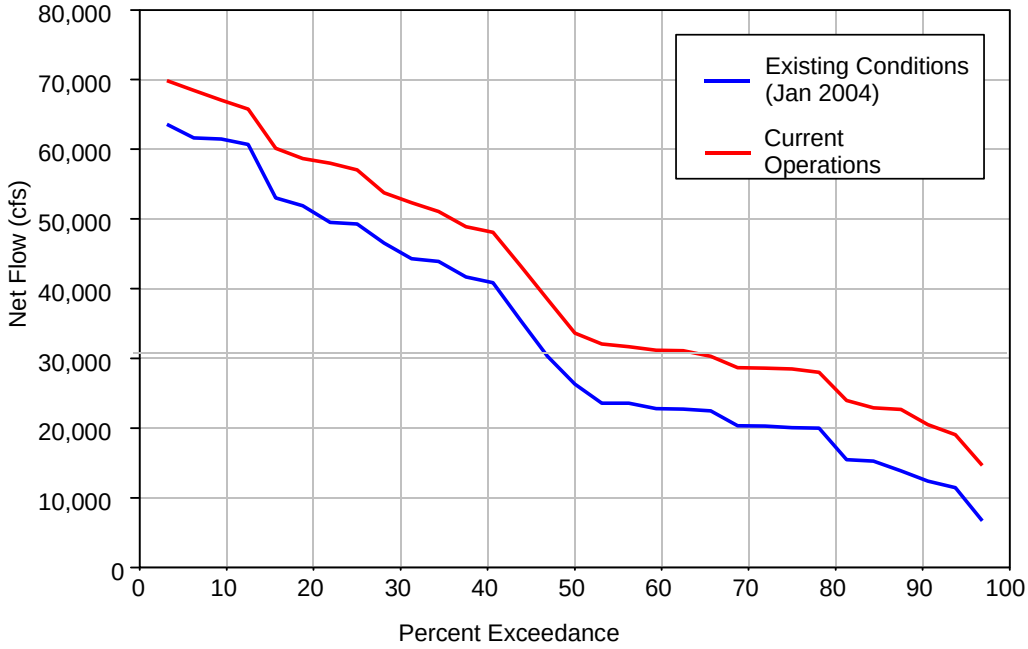
Delta waters and channels are also subject to large inflow from the Sacramento and San Joaquin River watershed. The Proposed Action would construct facilities in channels that convey a portion of the total runoff from the San Joaquin River watershed. Peak flood flows in early 1997 on the San Joaquin River in the south Delta (Vernalis) measured up to 75,000 cfs (USGS 2009). These peak flows are generally carried downstream in the main stem of the San Joaquin River, but approximately one-third of the waters are carried in the Old and Middle River segments.

The lands surrounding the Old River and Connection Slough sites are within the 100-year floodplains (Contra Costa County 2005, San Joaquin County 1992). A system of levees protects the lands on the neighboring islands (Holland Tract, Bacon Island, and Mandeville Island), which are below sea level.

3.9.1.2 Surface Water Quality

The SWRCB has adopted water quality control plans and policies to protect water quality and contribute to the protection of beneficial uses in the Bay-Delta Estuary. The Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan) was adopted in 1995 and amended in 2006. Water quality and water rights for the Delta were established via D-1485 (1978) and D-1641 (2000). When combined, the Bay-Delta Plan and applicable Water Right Decisions establish water quality objectives that consider the need for the protection of beneficial uses, including agricultural, domestic, and industrial uses by humans and the needs of the ecosystem. These establish the water quality objectives and set the conditions for water management in the Delta.

Except during period of large regional flood or runoff events, surface water quality in Old River and Connection Slough also is dominated by natural tidal variations and is affected by diversion pumping. Figure 3.9-19 illustrates the existing variation in salinity (expressed in µmho/cm). Additional flow and salinity information is available in Appendix



A.

Figure 3.9-3 Net Flow Exceedence for Historical (January 2004) and Simulated Current Operations at Chipps Island

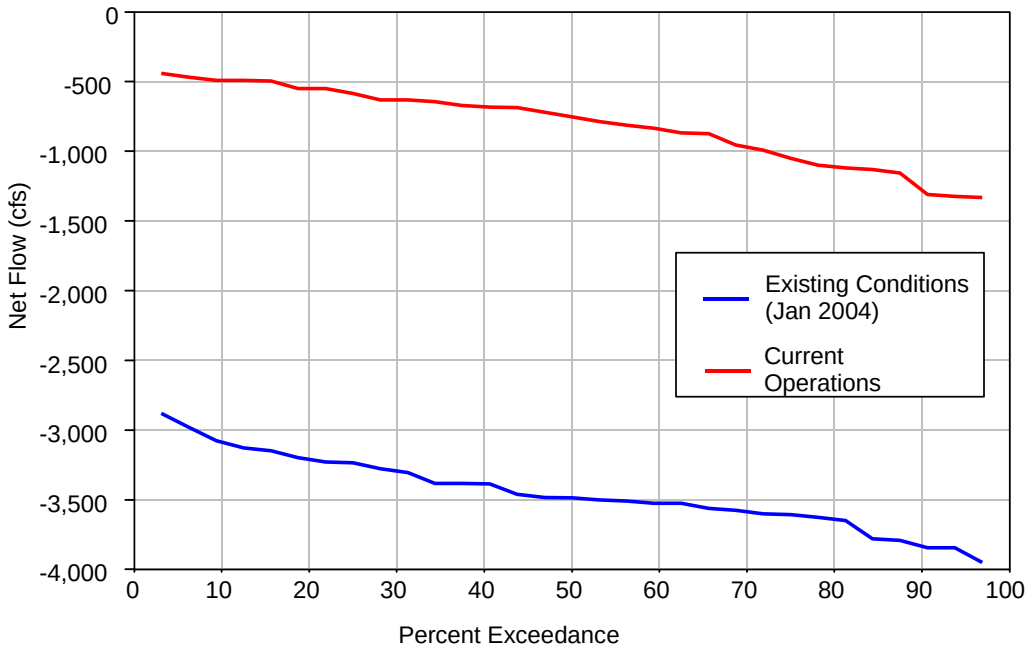


Figure 3.9-4 Net Flow Exceedance for Historical (January 2004) and Simulated Current Operations at MID (Middle River South of Woodward Canal)

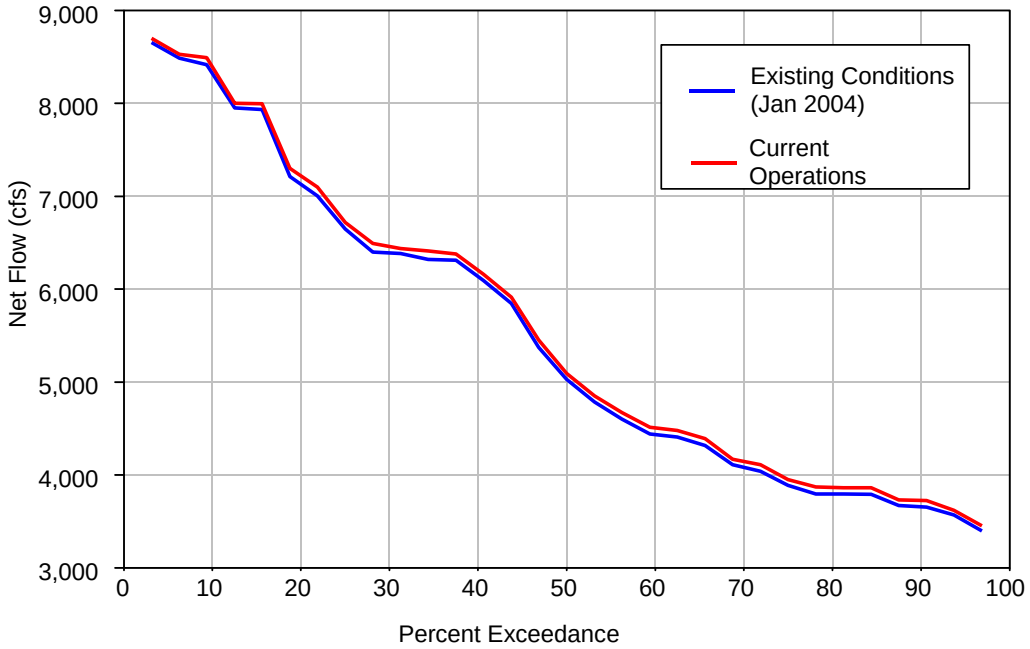


Figure 3.9-5 Net Flow Exceedence for Historical (January 2004) and Simulated Current Operations at Mokelumne River at San Joaquin River

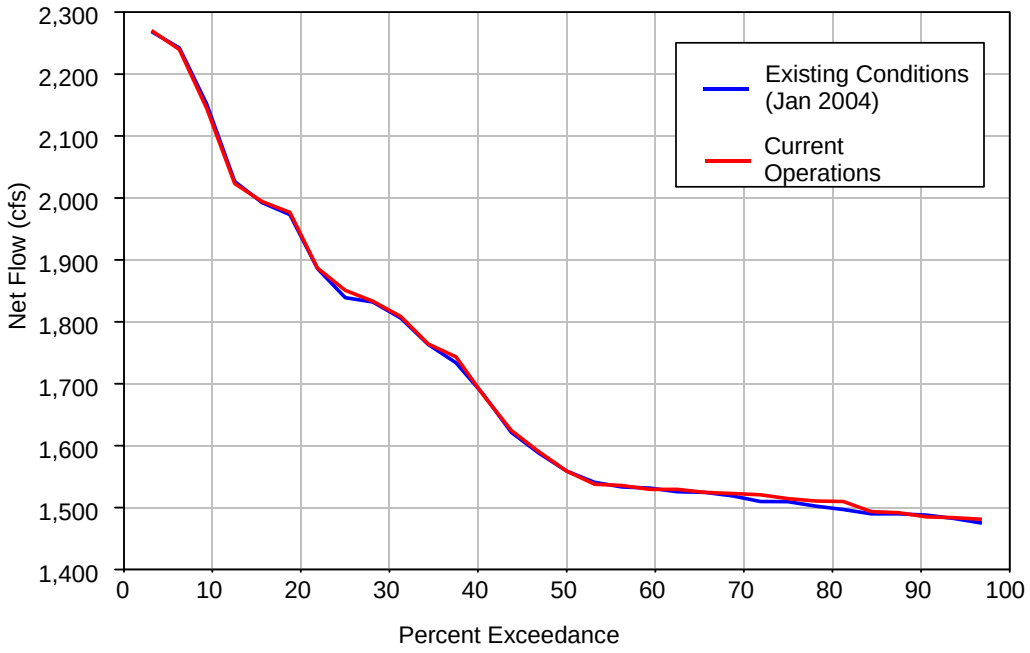


Figure 3.9-6 Net Flow Exceedence for Historical and Simulated Current Operations (RSAN087), San Joaquin River at Mossdale for January 2004

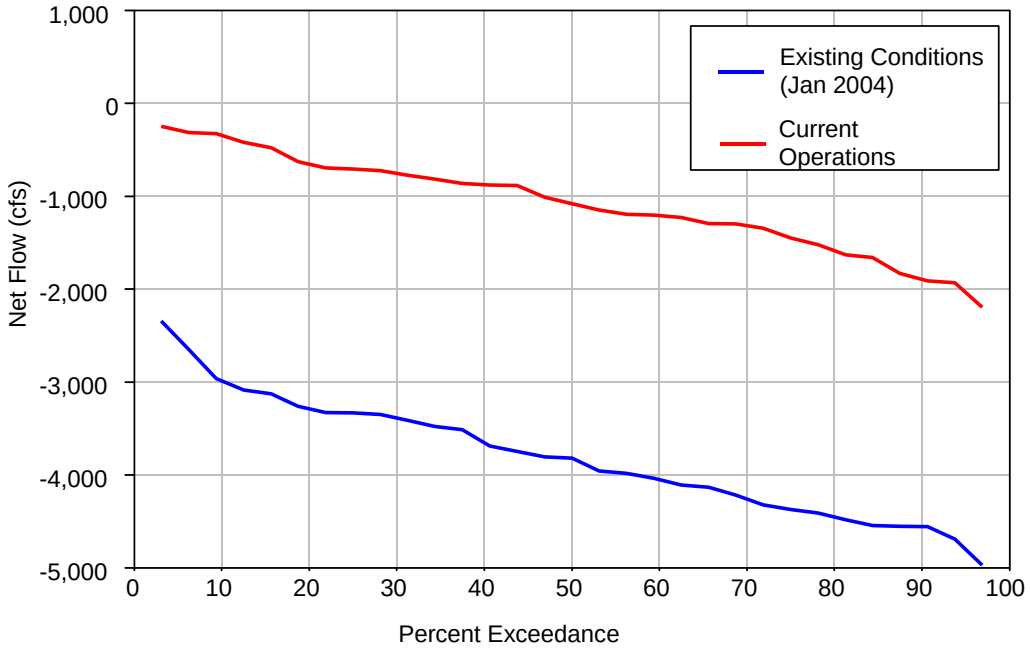


Figure 3.9-7 Net Flow Exceedence for Historical (January 2004) and Simulated Current Operations at MRC (Middle River at Medford Island)

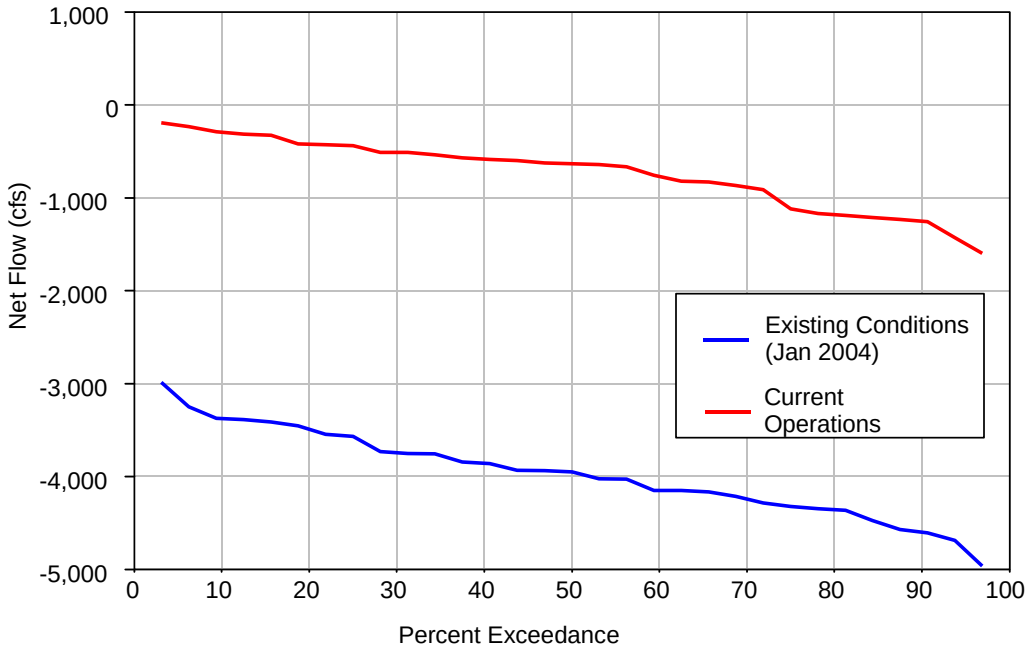


Figure 3.9-8 Net Flow Exceedence for Historical (January 2004) and Simulated Current Operations at OLD (ROLD024, Old River at Bacon Island)

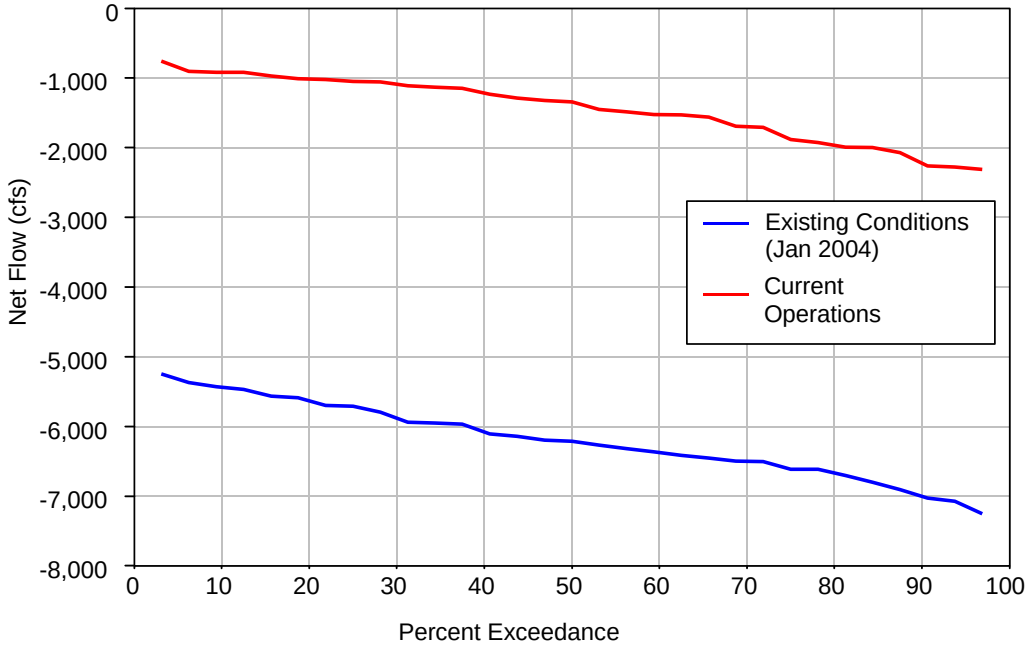


Figure 3.9-9 Net Flow Exceedence for Historical (January 2004) and Simulated Current Operations at OLF (ROLD034, Old River near Byron)

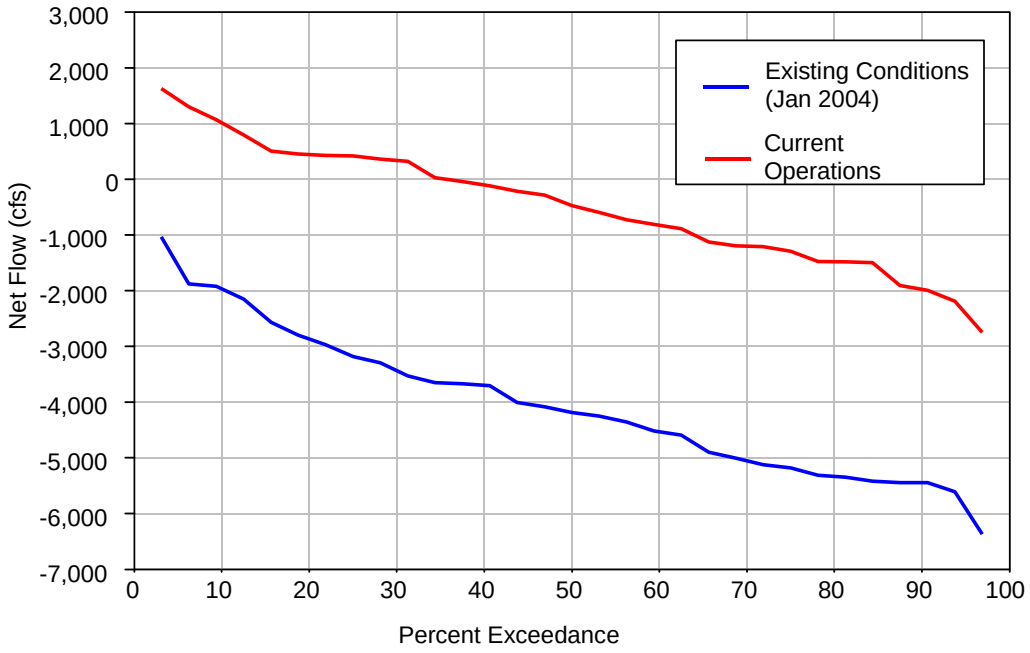


Figure 3.9-10 Net Flow Exceedence for Historical (January 2004) and Simulated Current Operations at PRI (Prisoner Point)

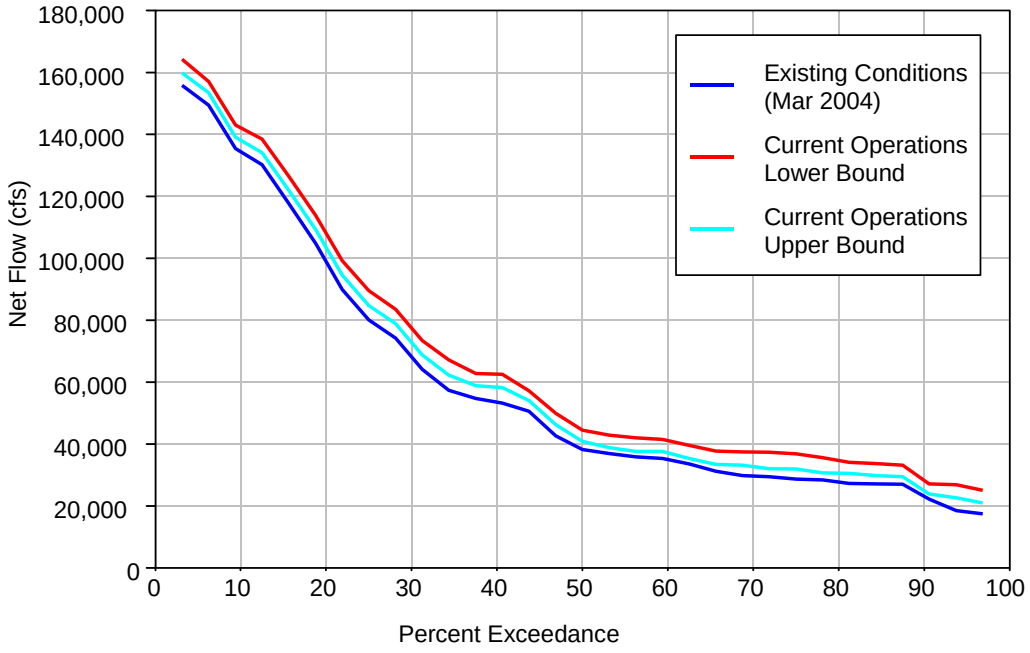


Figure 3.9-11 Net Flow Exceedence for Historical (March 2004) and Simulated Current Operations at Chipps Island

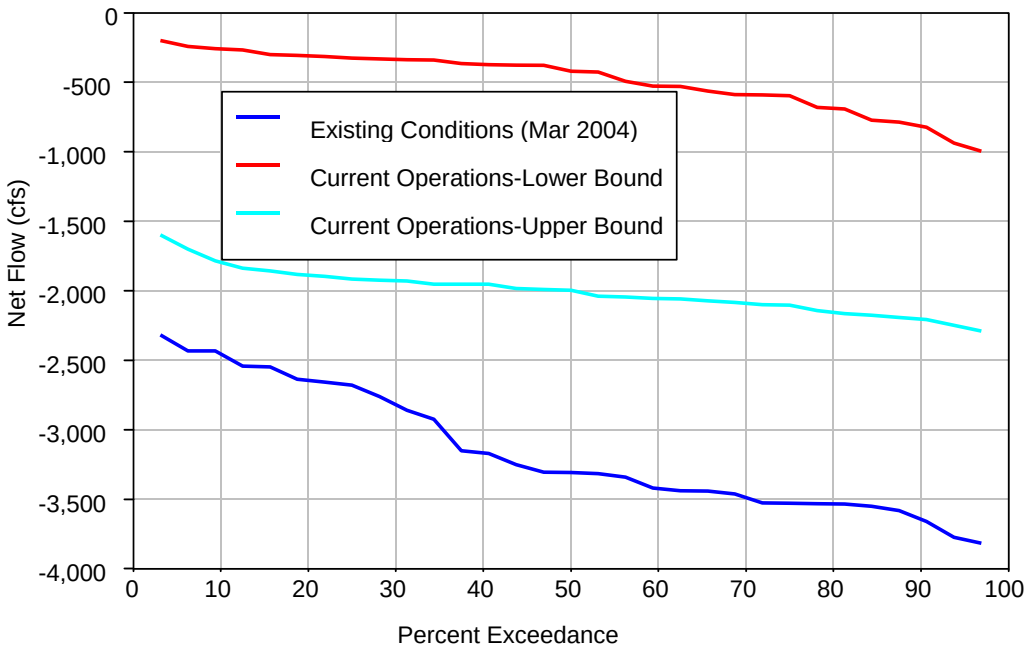


Figure 3.9-12 Net flow exceedence for Historical (March 2004) and Simulated Current Operations at MID (Middle River S of Woodward Canal

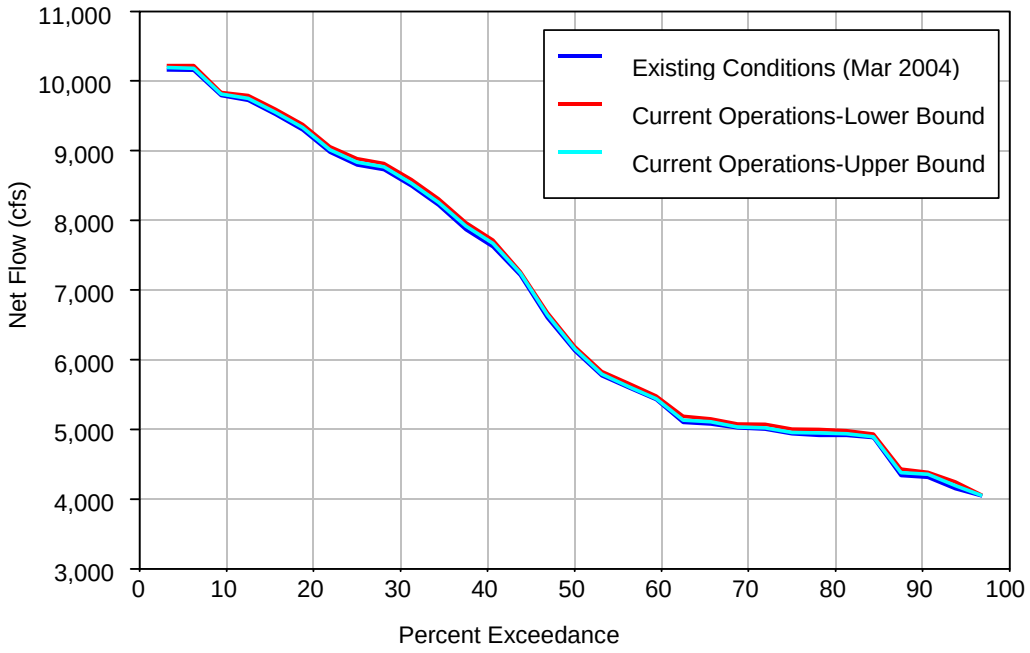


Figure 3.9-13 Net flow exceedence for Historical (March 2004) and Simulated Current Operations at MOK (Mokelumne River at San Joaquin River)

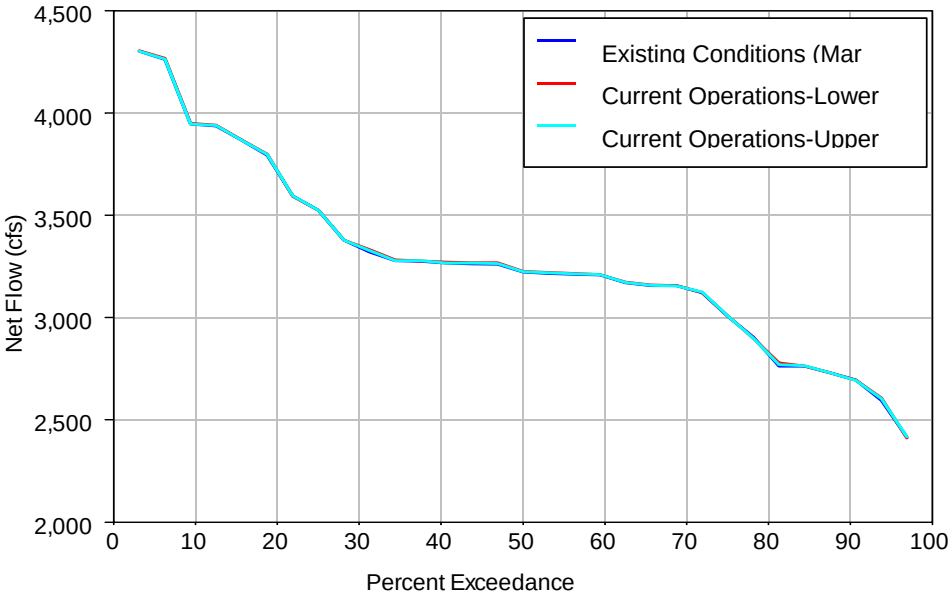


Figure 3.9-14 Net flow exceedence for Historical (March 2004) and Simulated Current Operations at MOS (RSAN087, San Joaquin River at Mossdale)

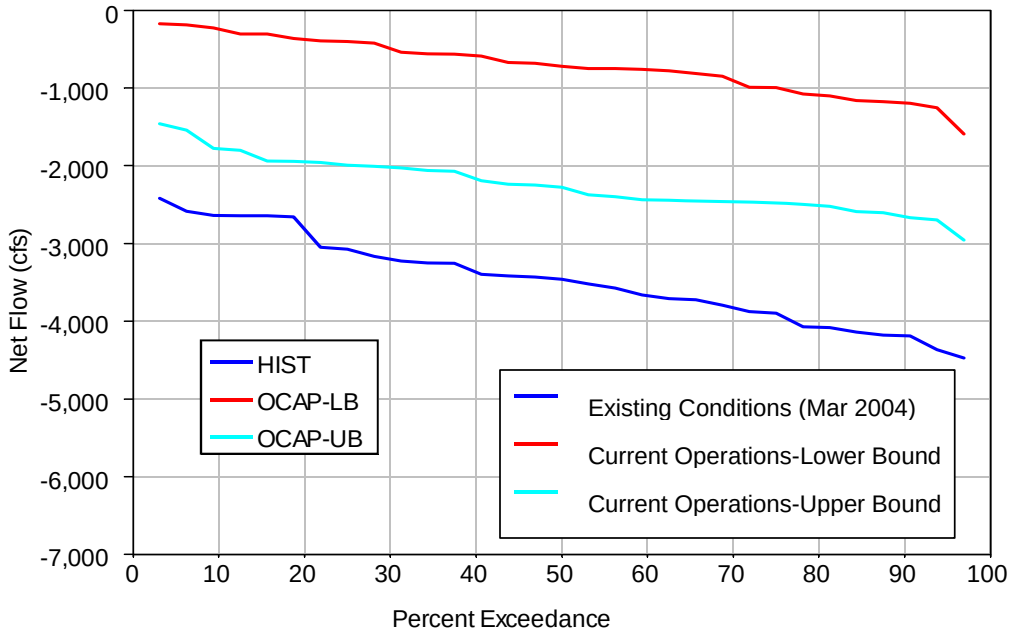


Figure 3.9-15 Net flow exceedence for Historical (March 2004) and Simulated Current Operations at MRC (Middle River at Medford Island)

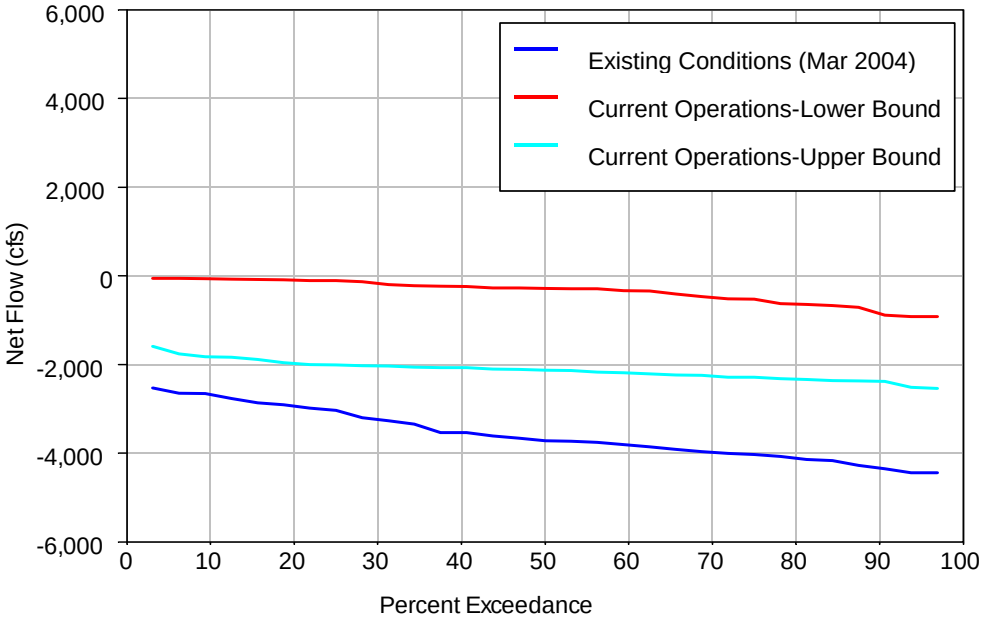


Figure 3.9-16 Net flow exceedence for Historical (March 2004) and Simulated Current Operations at OLD (ROLD024, Old River at Bacon Island)

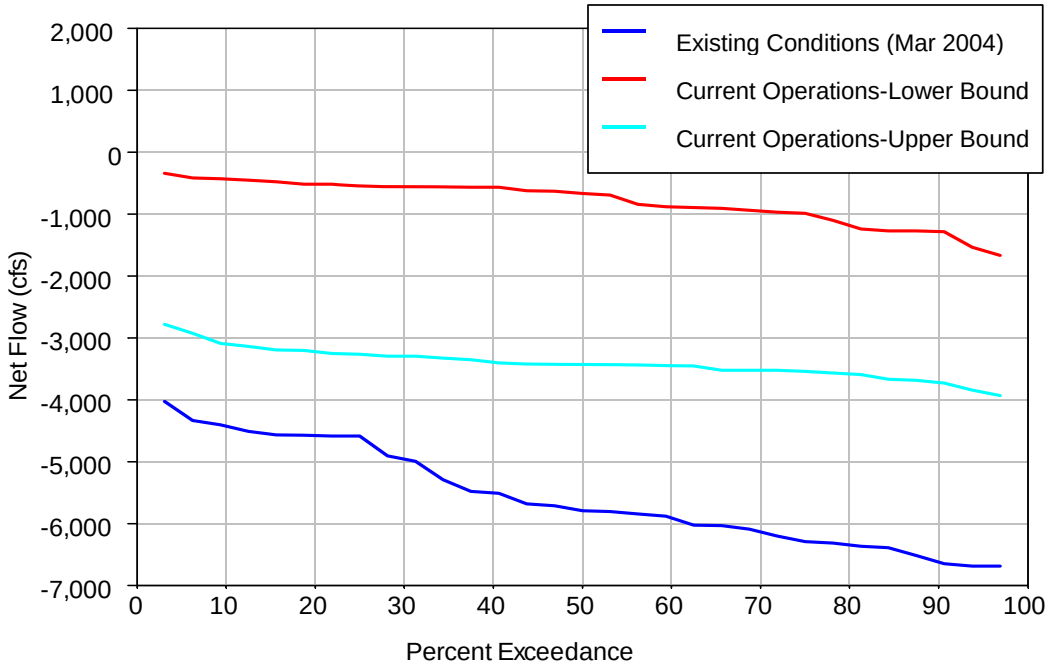


Figure 3.9-17 Net flow exceedence for Historical (March 2004) and Simulated Current Operations at OLF (ROLD034, Old River near Byron)

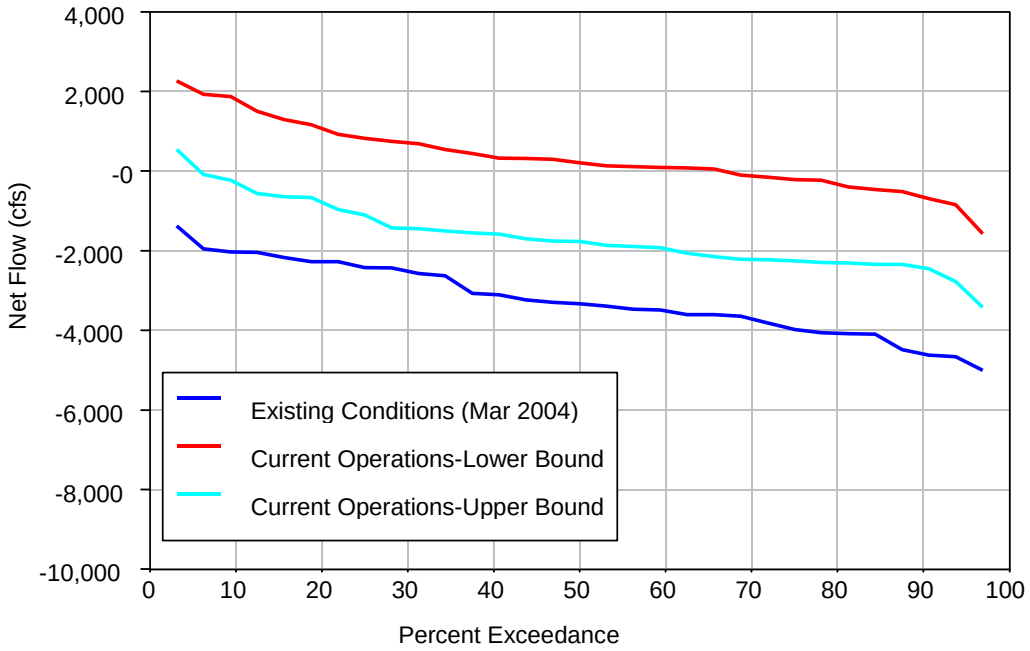


Figure 3.9-18 Net flow exceedence for Historical (March 2004) and Simulated Current Operations at PRI (Prisoners Point)

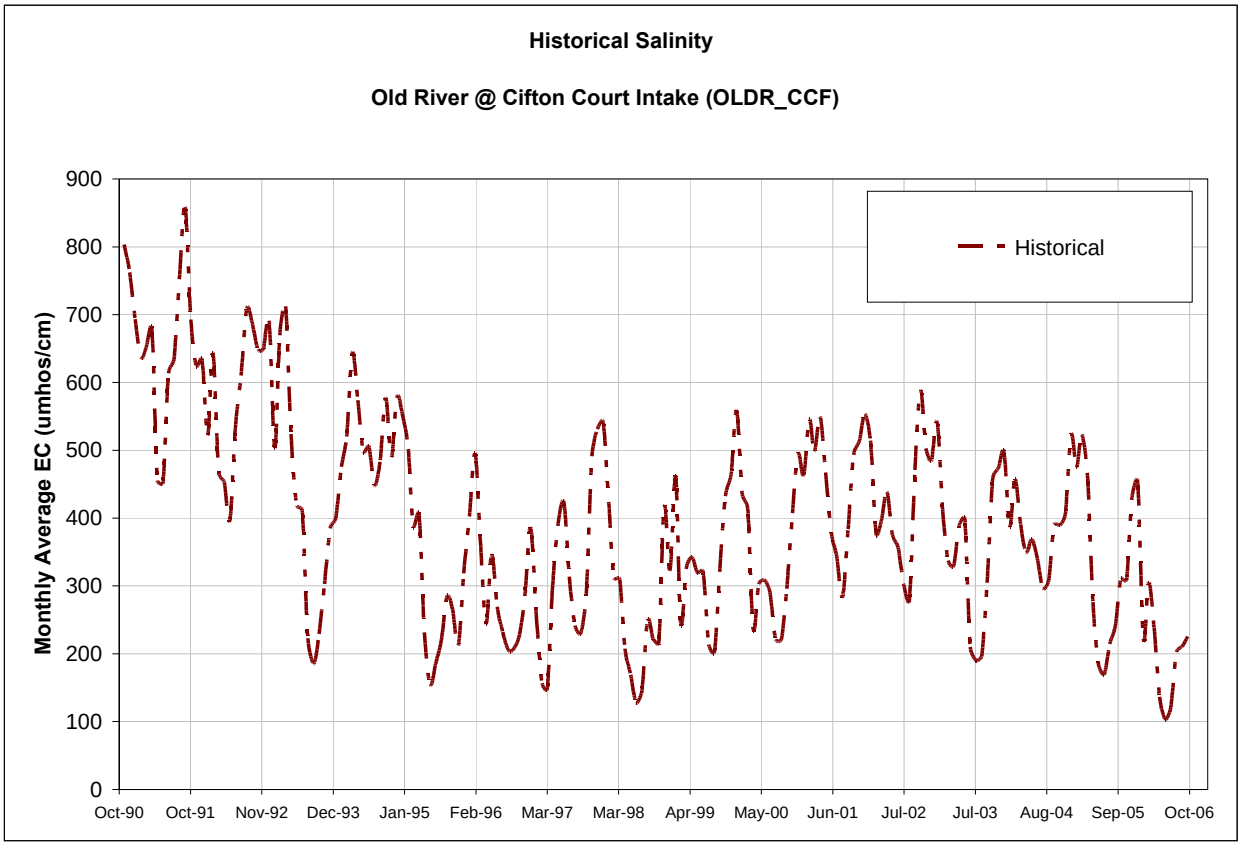


Figure 3.9-19 Monitored Salinity (µmho/cm) near the Proposed Action Locations

General water quality in the Delta has been the subject of much analysis debate with regard to its intended use. At some times and in some locations water quality in the Delta has been determined to be in violation of water quality objectives and impaired its beneficial uses. These violations have led to the development of Total Maximum Daily Load (TMDL) programs in an effort to control the input of these pollutants from their sources, including municipal, domestic, industrial, and agricultural wastewater and stormwater (Lee and Jones-Lee 2004). Delta waters have been impaired by many factors including:

- Bioaccumulation of organochlorine "legacy" pesticides and other toxic materials (dichlorodiphenyltrichloroethane [DDT], chlordane, dieldrin, polychlorinated biphenyls [PCBs], dioxins/furans, and heavy metals), organophosphorus-based pesticides, and pyrethroid-based pesticides that are a threat to the health of those who use some types of Delta fish as food.
- Elevated concentrations of total organic carbon and nutrients (principally nitrogen and phosphorus compounds), which stimulate algal and other plant growth and require additional treatment prior to the use as a domestic water supply source to control excessive trihalomethanes. The added nutrients also cause taste and odor issues in the water supply.
- Influent water, principally from the San Joaquin River, also carries salts and other dissolved solids that exceed water quality objectives and is an important issue for agriculture relying on Delta waters.

- Excessive algal and aquatic weed growth can contribute to a reduction in dissolved oxygen. This may result in the degradation of the rest of the aquatic ecosystem including fish kills.
- Invasive and non-native aquatic organisms have also resulted in the change in water quality and are suspected to be a major contributor to other ecosystem changes in the Delta.
- Population growth in the surrounding and adjacent watershed has increased point and non-point pollution, including the addition of ammonia and other common chemical compounds.

3.9.1.3 Groundwater

The Project sites are located in the Tracy Subbasin of the Great Valley Geomorphic Province (DWR 2006). The Tracy Subbasin is composed of four defined strata: the Tulare Formation, Older Alluvium, Flood Basin Deposits, and Younger Alluvium. The Flood Basin Deposits consist primarily of silts and clays between the Younger Alluvium and older and deeper sediments, and include occasional gravel interbeds in areas adjacent to existing waterways. Because of their fine-grained nature, the flood basin deposits have low permeability and correspondingly low yields to water wells. Occasional zones of fresh water are found in these basin deposits, but they generally contain poor quality groundwater. The Younger Alluvium aquifer unit includes sediments deposited in the channels of active streams as well as overbank deposits and terraces of those streams. This unit is locally highly permeable and is less than 100 feet thick.

3.9.2 Regulatory Setting

3.9.2.1 Federal

Clean Water Act (CWA)

The Environmental Protection Agency is the federal agency responsible for water quality management and administers the federal Water Pollution Control Act Amendments of 1972 and 1987, collectively known as the CWA. The CWA establishes the principal federal statutes for water quality protection. It was established with the intent "to restore and maintain the chemical, physical, and biological integrity of the nation's water, to achieve a level of water quality which provides for recreation in and on the water, and for the propagation of fish and wildlife." Several key sections of the CWA guide the regulation of water pollution in the United States:

- **Section 208, Water Quality Control Plans**. This section requires the preparation of local water quality control plans throughout the nation. Each water quality control plan covers a defined drainage area. The primary goal of each water quality control plan is to attain water quality standards established by the CWA and the state governments within the defined area of coverage. Minimum content requirements, preparation procedures, time constraints, and federal grant funding criteria pertaining to the water quality control plans are established in Section 208. Preparation of the water quality control plans has been delegated to the individual states by the EPA.
- **Section 401, Water Quality Certifications**. This section of CWA requires that, prior to the issuance of a federal license or permit for an activity or activities that may result in a discharge of pollutants into navigable waters (see Section 404 discussion, below), the permit applicant must first obtain a certification from the state in which the discharge would

originate. A state certification indicates that the proposed activity or activities would not result in a violation of applicable water quality standards established by federal or state law, or that there are no water quality standards that apply to the proposed activity.

- **Section 402, NPDES.** The NPDES requires permits for pollution discharges into water bodies such that the permitted discharge does not cause a violation of federal and state water quality standards. NPDES permits define quantitative and/or qualitative pollution limitations for the permitted source, and control measures that must be implemented to achieve the pollution limitations. Pollution control measures are often referred to as BMPs.
- **Section 404, Discharge of Dredge and Fill Material.** Section 404 assigns the U.S. Army Corps of Engineers (Corps) with permitting authority for proposed discharges of dredged and fill material into waters of the U.S., defined as "…waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; territorial seas and tributaries to such waters."

The Corps typically considers all natural drainages with defined beds and banks to be waters of the U.S. Section 404 establishes procedures by which the permitting agency is to review, condition, approve, and deny permit requests. Per the regulations, the Corps is responsible for conducting public noticing and providing the opportunity for public hearings during the review of each permit request. This includes informing USFWS and/or the NMFS of each permit request. Consultation with USFWS and/or NMFS is required for proposed discharges that could affect species protected by the federal ESA. Measures that are required by USFWS and/or NMFS to minimize impacts to federally protected species must be included as conditions of the permit.

Rivers and Harbors Act

The Rivers and Harbors Act (RHA) of 1899 prohibits the unauthorized alteration or obstruction of any navigable waters of the United States. As defined by the RHA, navigable waters include all waters that are:

- Historically, presently, or potentially used for interstate or foreign commerce and
- Subject to the ebb and flow of tides

Regulations implementing Section 10 of the RHA are coordinated with regulations implementing CWA Section 404. The RHA specifically regulates:

- Construction of structures in, under, or over navigable waters
- Deposition or excavation of material in navigable waters
- All work affecting the location, condition, course, or capacity of navigable waters

The RHA is administered by the Corps. If a proposed activity falls under the authority of RHA Section 10 and CWA Section 404, the Corps processes and issues a single permit. For activities regulated only under RHA Section 10, such as installation of a structure not requiring fill, permit conditions may be added to protect water quality during construction. The San Joaquin River is

considered a navigable water between the mouth of the river and Sycamore Road (a point about 7 miles downstream of U.S. Highway 99 near Fresno).

National Flood Insurance Program

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP). FEMA has completed Flood Insurance Rate Maps that identify Special Flood Hazard Areas in the Project area. To comply with the NFIP, communities must adopt a floodplain management ordinance addressing construction and habitation in flood zones. In California, DWR provides and encourages communities to adopt the California Model Floodplain Management Ordinance.

Executive Order 11988-Floodplain Management

EO 11988 requires federal agencies to recognize the values of floodplains and to consider the public benefits from restoring and preserving floodplains. Under this order each federal agency is required to take action and provide leadership to:

- Avoid development in the base floodplain
- Reduce the risk and hazard associated with floods
- Minimize the impact of floods on human health, welfare, and safety and
- Restore and preserve the beneficial and natural values of the base floodplain.

3.9.2.2 State

Porter-Cologne Act

The Porter-Cologne Act (California Water Code Section 13000) is the principal law governing water quality regulation in California. It establishes a comprehensive program to protect water quality and the beneficial uses of water. The Porter-Cologne Act applies to surface waters, wetlands, and groundwater, and to both point and non-point sources of pollution. Pursuant to the Porter-Cologne Act, it is the policy of the State of California that:

- The quality of all the waters of the State shall be protected
- All activities and factors affecting the quality of water shall be regulated to attain the highest water quality within reason and
- The State must be prepared to exercise its full power and jurisdiction to protect the quality of water in the State from degradation

Pursuant to the Porter-Cologne Act, the responsibility for protection of water quality in California rests with the SWRCB. The SWRCB administers federal and state water quality regulations for California's ocean waters and also oversees and funds the state's nine RWQCBs. The RWQCBs prepare water quality control plans, establish water quality objectives, and carry out federal and state water quality regulations and permitting duties for inland water bodies, enclosed bays, and estuaries within their respective regions. The Porter-Cologne Act gives the SWRCB and RWQCBs broad powers to protect water quality by regulating waste discharge to water and land and by requiring clean up of hazardous wastes.

Section 401 Water Quality Certification

The CVRWQCB has jurisdiction over issues concerning CWA Section 401 Water Quality Certifications for the Project site.

Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Estuary (Bay-Delta Plan)

The Water Quality Control Plans from all nine of the RWQCBs and the California Ocean Plan (prepared and implemented by the SWRCB) collectively constitute the State Water Quality Control Plan. However, the SWRCB (2006) prepared the Bay-Delta Plan to supplement the other water quality control plans adopted by the SWRCB and RWQCBs, and State policies for water quality control as they relate to the Bay-Delta Estuary watershed. The Bay-Delta Plan has been designed to support the intentions of the CWA and the Porter-Cologne Act by: (1) characterizing watersheds within the Delta; (2) identifying beneficial uses that exist or have the potential to exist in each water body; (3) establishing water quality objectives for each water body to protect beneficial uses or allow their restoration, and; (4) providing an implementation program that achieves water quality objectives. Implementation program measures include monitoring, permitting, and enforcement activities.

Storm Water Permit

Construction activities that involve 0.5 or more acres of land disturbance must comply with the General Permit for Discharges of Storm Water Associated with Construction Activity (Construction General Permit, 99-08-DWQ), which regulates stormwater originating from construction activities. Construction activity subject to this permit includes clearing, grading and disturbances to the ground such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility.

The Construction General Permit requires the development and implementation of a SWPPP. Section A of the Construction General Permit describes the elements that must be contained in a SWPPP. These elements include a site map(s) that shows the construction site perimeter, existing and proposed buildings, lots, roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the project. The SWPPP must list the BMPs the discharger will use to protect storm water runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment.

The SWRCB is in the process of reissuing the Construction General Permit and released a preliminary draft of the new permit on March 2, 2007 (SWRCB 2007). A revision to the draft was released in March 2008. When adopted, this permit will replace the 1999 Construction General Permit and, as proposed, would require the permittee to implement additional minimum BMPs. The revised draft permit also requires specific analytical procedures to determine whether the BMPs are preventing further impairment due to sediment and preventing non-visible pollutants from violating water quality objectives. The new requirements would require monitoring (i.e., sampling and testing) of the quality of stormwater discharges at most sites. In

addition, all sites would be required to meet new development and redevelopment performance standards to minimize or mitigate hydrologic impacts.

Fish and Game Code, Sections 1601 to 1603

Under Sections 1601 to 1603 of the Fish and Game Code, DFG must be notified prior to any project that would divert, obstruct, or change the natural flow, bed, channel, or bank of any river, stream, or lake. The term "stream" can include intermittent and ephemeral streams, rivers, creeks, dry washes, sloughs, blueline streams, and watercourses with subsurface flows. The non-federal project proponent will apply for a Streambed Alteration Agreement from DFG.

3.9.3 Environmental Consequences

3.9.3.1 No Action Alternative

The No Action alternative would not affect surface or groundwater hydrology or water quality because no gates or other facilities would be constructed across the Old River or Connection Slough channels or on adjacent lands. Hydrologic and water quality conditions would remain as they have in the past. The CVP and SWP would continue to operate within existing regulatory restrictions.

3.9.3.2 Proposed Action

Construction

Construction would occur primarily within the Old River and Connection Slough channels and generally would not require grading or other topographic modifications. Channel bottom material would be dredged and disposed of on the northeast corner of Bacon Island; excess material would be disposed of on Roberts Island at an existing disposal site. On Bacon Island, the dredged material would be confined within a bermed area and would not result in erosion or siltation. Dredging for the foundation for the barge-mounted gates would result in a short-term increase in sediment load in a channel. This increase in turbidity would dissipate quickly as suspended particles settled to the bottom after dredging was complete. Moreover, as described in Section 2, turbidity and other water quality parameters would be monitored during in-water construction, and work would cease as needed to prevent exceedence of the standards approved by the regulatory agencies.

No storm water drainage systems are in place at the proposed sites; runoff enters the waterways. The only potential source of runoff water would be associated with dredged material disposal. The channel bottoms would be dredged with a clamshell, and the dredged material would be placed in a bermed disposal site on Bacon Island or Roberts Island. Material would be largely dewatered by the time it was placed in the storage areas, and the berms would confine any potential runoff. The dredged material is not expected to contain contaminants such as heavy metals because it is in a rural area, well-removed from industrial uses. The runoff from the dredge material disposal site would be controlled using standard BMPs for such sites.

Operations

Implementation of the Proposed Action would temporarily alter the flow path and velocity for tidal and watershed discharge flows through Old River and Connection Slough (and adjacent Delta channels) and thereby change one of the principal components of delta smelt habitat in the

central and south Delta. These changes in peak flow would vary depending on the timing, amount and other characteristic (principally turbidity) of inflow from the Sacramento-San Joaquin Rivers watershed. Changes to the movement of water and the timing of water movements were evaluated using the RMA-Delta Model and the DSM2 computer model. The RMA-Delta Model (described in more detail in Appendix A) and DSM2[5] calculate stages, flows, velocities; many water quality parameters, and the movement of individual particles. The RMA-Delta Model has been enhanced to simulate the upstream movement of delta smelt.

Hydrology

Flow Rates. When the gates were closed, the Proposed Action would alter the regional flow-path of water in some portions of the Delta. These changes are shown in Table 3.9-3 for the period designed to protect adult delta smelt and Tables 3.9-4 and 3.9-5 for the juvenile delta smelt period. The greatest change to flow rates would be found in channels immediately adjacent to the Proposed Action 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). When the gates are open, the Proposed Action would have a negligible effect on Delta hydrology and water quality. Detailed results are available in Appendix A

Figures 3.9-20 through Figure 3.9-27 display the range of modeled net flow comparing current operations and the flow from the implementation of the Proposed Action at selected locations in the Delta. The month of January was selected as representative of conditions in the Delta when the Proposed Action would be operated for the protection of adult delta smelt. Likewise, Figures 3.9-28 through 3.9-35 display the range of simulated net flow comparing current operations and the flow from the implementation of the Proposed Action at selected locations in the Delta. The month of March was selected as representative of conditions in the Delta in the spring and early summer when the Proposed Action would be operated for the protection of juvenile and larval delta smelt. These results were obtained through the use of the RMA-Delta Model (Appendix A).

Water levels (also known as stage or water surface elevation) in the Delta vary as a result of tides and the balance of inflows and withdrawals. The tidal influence on water elevation (and tidal timing) is different for different locations in the Delta. The range of difference is greatest in the western Delta and generally decreases at the upstream edges of the Delta.

[5] Detailed descriptions of DSM2 are available at http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dsm2/dsm2.cfm.

Table 3.9-3 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during January-February 2004											
		Ebb Tide						Flood Tide					
		January			February			January			February		
Station Name	Code	Current Operations	Proposed Action	% Change	Current Operations	Proposed Action	% Change	Current Operations	Proposed Action	% Change	Current Operations	Proposed Action	% Change
Chipps Island		442,671	440,997	0%	456,090	454,538	0%	-386,759	-386,185	0%	-369,202	-368,106	0%
False River	FAL	56,240	55,340	-2%	54,715	53,789	-2%	-60,552	-61,353	-1%	-62,003	-61,442	1%
Sacramento River @ Freeport	FPT	61,877	61,874	0%	75,071	75,071	0%	17,507	17,500	0%	15,921	15,927	0%
Grant Line Canal	GLC	6,361	6,361	0%	6,213	6,250	1%	-5,345	-5,448	-2%	-5,012	-5,175	-3%
Old River at Holland Cut	HOL	29,612	16,976	-43%	29,112	16,768	-42%	-31,728	-21,177	33%	-33,618	-22,018	35%
Jersey Point	JPT	159,472	159,641	0%	157,996	158,154	0%	-161,246	-160,569	0%	-157,081	-155,983	1%
Middle River S of Woodward Cut	MID	6,741	6,638	-2%	7,051	6,984	-1%	-9,438	-9,587	-2%	-9,353	-9,533	-2%
Mokelumne River @ SJR	MOK	21,488	21,857	2%	22,563	22,731	1%	-13,091	-14,582	-11%	-12,799	-14,602	-14%
Mossdale	RSAN087	2,929	2,917	0%	4,455	4,454	0%	-148	-149	0%	-101	-117	-16%
Middle River @ Medford Island	MRC	31,292	37,012	18%	30,612	35,617	16%	-37,843	-47,566	-26%	-38,881	-50,264	-29%
Old River @ Bacon Island	ROLD024	13,498	15,369	14%	13,580	15,430	14%	-16,856	-19,007	-13%	-16,487	-19,714	-20%
Old River W of Victoria Island	ROLD034	7,995	8,042	1%	8,643	8,686	1%	-11,761	-12,146	-3%	-11,690	-11,956	-2%

Table 3.9-3 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during January-February 2004											
		Ebb Tide						Flood Tide					
		January			February			January			February		
Station Name	Code	Current Operations	Proposed Action	% Change	Current Operations	Proposed Action	% Change	Current Operations	Proposed Action	% Change	Current Operations	Proposed Action	% Change
Old River @ San Joaquin River	OSJ	11,390	18,582	63%	10,662	18,814	76%	-13,509	-19,256	-43%	-15,867	-21,982	-39%
Prisoners Point	PRI	63,899	73,984	16%	62,101	71,384	15%	-75,408	-90,169	-20%	-79,676	-94,854	-19%
Rio Vista	RSAC101	143,270	143,481	0%	197,193	197,180	0%	-102,473	-102,722	0%	-100,547	-101,149	-1%
Middle River @ Middle River	RMID015	12,485	10,495	-16%	12,816	10,929	-15%	-16,977	-15,843	7%	-16,989	-15,772	7%
Cache Slough @ Ryer Island	RYI	97,616	97,904	0%	140,896	140,890	0%	-96,081	-96,156	0%	-91,321	-91,427	0%
San Andreas	SAN	118,980	119,100	0%	115,539	115,756	0%	-125,249	-126,456	-1%	-124,856	-125,747	-1%
Threemile Slough	SLTRM004	27,568	27,528	0%	27,220	27,203	0%	-36,818	-37,023	-1%	-40,107	-39,715	1%
Turner Cut	TRC	2,256	2,908	29%	2,227	2,948	32%	-3,319	-4,460	-34%	-3,189	-4,240	-33%
Victoria Canal	VIC	3,359	3,293	-2%	3,736	3,644	-2%	-5,556	-5,671	-2%	-5,585	-5,620	-1%

Table 3.9-4 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in March 2004

		Juvenile Period - March 2004											
		Ebb Tide						Flood Tide					
		Lower Bound		Upper Bound				Lower Bound		Upper Bound			
Station Name	Code	Current Operations	Proposed Action	Current Operations	Proposed Action	% change Lower Bound	% change Lower Bound	Current Opera-tions	Proposed Action	Current Opera-tions	Proposed Action	% change Lower Bound	% change Lower Bound
Chipps Island		443,911	440,718	441,965	439,116	-1%	-1%	-369,456	-372,369	-373,235	-376,864	-1%	-1%
False River	FAL	52,949	50,900	52,427	49,772	-4%	-5%	-59,915	-57,195	-60,662	-57,551	5%	5%
Sacramento River @ Freeport	FPT	72,797	72,795	72,796	72,793	0%	0%	23,305	23,269	23,297	23,270	0%	0%
Grant Line Canal	GLC	6,320	5,975	6,597	6,147	-5%	-7%	-4,082	-2,073	-4,206	-2,133	49%	49%
Old River at Holland Cut	HOL	27,800	15,672	26,935	21,667	-44%	-20%	-31,637	-10,111	-32,476	-16,367	68%	50%
Jersey Point	JPT	153,504	150,217	151,907	147,850	-2%	-3%	-156,824	-152,306	-158,917	-154,319	3%	3%
Middle River S of Woodward Cut	MID	6,818	6,369	6,141	5,674	-7%	-8%	-8,538	-9,359	-9,643	-10,148	-10%	-5%
Mokelumne River @ SJR	MOK	21,066	21,887	21,053	22,101	4%	5%	-11,649	-13,473	-11,448	-13,440	-16%	-17%
Mossdale	RSAN087	4,681	4,639	4,653	4,609	-1%	-1%	1,968	1,989	2,007	2,010	1%	0%
Middle River @ Medford Island	MRC	29,865	34,319	29,056	32,925	15%	13%	-37,556	-51,245	-38,578	-52,555	-36%	-36%
Old River @ Bacon Island	ROLD024	13,254	14,511	12,541	13,706	9%	9%	-15,759	-3,901	-16,740	-1,671	75%	90%

Table 3.9-4 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in March 2004

		Juvenile Period - March 2004											
		Ebb Tide						Flood Tide					
		Lower Bound		Upper Bound				Lower Bound		Upper Bound			
Station Name	Code	Current Operations	Proposed Action	Current Operations	Proposed Action	% change Lower Bound	% change Lower Bound	Current Opera-tions	Proposed Action	Current Opera-tions	Proposed Action	% change Lower Bound	% change Lower Bound
Old River W of Victoria Island	ROLD034	8,342	7,966	7,331	6,951	-5%	-5%	-10,496	-6,566	-13,150	-8,272	37%	37%
Old River @ San Joaquin River	OSJ	10,738	18,858	10,516	18,756	76%	78%	-13,979	-22,503	-14,473	-22,206	-61%	-53%
Prisoner Point	PRI	60,957	71,704	59,954	70,598	18%	18%	-78,691	-96,856	-80,261	-98,755	-23%	-23%
Rio Vista	RSAC101	190,228	190,906	190,444	191,299	0%	0%	-94,199	-94,387	-94,149	-94,357	0%	0%
Middle River @ Middle River	RMID015	12,562	10,145	11,593	9,220	-19%	-20%	-15,980	-26,438	-17,398	-28,004	-65%	-61%
Cache Slough @ Ryer Island	RYI	134,237	134,724	134,420	135,043	0%	0%	-93,606	-93,625	-93,478	-93,493	0%	0%
San Andreas	SAN	115,083	112,353	113,631	110,120	-2%	-3%	-124,296	-122,271	-126,708	-124,409	2%	2%
Threemile Slough	SLTRM004	25,701	24,660	25,277	23,996	-4%	-5%	-37,641	-36,237	-38,246	-36,766	4%	4%
Turner Cut	TRC	2,127	3,038	1,910	2,722	43%	43%	-3,276	-6,041	-3,558	-6,219	-84%	-75%
Victoria Canal	VIC	3,620	3,344	3,133	2,664	-8%	-15%	-5,036	-6,590	-6,908	-8,176	-31%	-18%

Table 3.9-5 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in June 2004

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during June 2004											
		Ebb Tide						Flood Tide					
		Lower Bound		Upper Bound				Lower Bound		Upper Bound			
Station Name	Code	Current Operations	Proposed Action	Current Operations	Propose d Action	% change Lower Bound	% change Lower Bound	Current Operations	Proposed Action	Current Operations	Proposed Action	% change Lower Bound	% change Lower Bound
Chipps Island		425,783	421,024	424,951	420,002	-1%	-1%	-409,224	-412,285	-410,782	-414,874	-1%	-1%
False River	FAL	55,846	54,039	55,754	54,054	-3%	-3%	-61,621	-59,544	-61,964	-59,575	3%	4%
Sacramento River @ Freeport	FPT	19,652	19,652	19,668	19,668	0%	0%	5,195	4,676	5,196	4,668	-10%	-10%
Grant Line Canal	GLC	6,030	5,865	5,902	5,724	-3%	-3%	-4,275	-4,275	-4,645	-4,298	0%	7%
Old River at Holland Cut	HOL	30,785	19,486	30,446	28,537	-37%	-6%	-32,293	-21,351	-32,606	-32,287	34%	1%
Jersey Point	JPT	157,777	153,314	157,393	152,782	-3%	-3%	-165,173	-160,164	-166,119	-161,240	3%	3%
Middle River S of Woodward Cut	MID	6,001	5,766	5,672	5,378	-4%	-5%	-9,954	-10,013	-9,973	-10,451	-1%	-5%
Mokelumne River @ SJR	MOK	17,608	18,913	17,622	18,958	7%	8%	-14,098	-16,158	-14,014	-16,205	-15%	-16%
Mossdale	RSAN0 87	2,127	2,070	2,106	2,176	-3%	3%	-289	-21	-174	83	93%	148%
Middle River @ Medford Island	MRC	31,681	36,768	31,471	36,486	16%	16%	-38,649	-51,345	-39,149	-51,987	-33%	-33%
Old River @ Bacon Island	ROLD0 24	13,616	14,874	13,428	14,656	9%	9%	-17,172	-17,158	-17,628	-17,155	0%	3%
Old River W of	ROLD0	6,981	7,009	6,384	6,447	0%	1%	-12,730	-12,730	-13,294	-12,755	0%	4%

Table 3.9-5 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in June 2004

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during June 2004											
		Ebb Tide						Flood Tide					
		Lower Bound		Upper Bound				Lower Bound		Upper Bound			
Station Name	Code	Current Operations	Proposed Action	Current Operations	Propose d Action	% change Lower Bound	% change Lower Bound	Current Operations	Proposed Action	Current Operations	Proposed Action	% change Lower Bound	% change Lower Bound
Victoria Island	34												
Old River @ San Joaquin River	OSJ	12,178	19,792	12,089	19,919	63%	65%	-13,698	-23,900	-13,856	-23,572	-74%	-70%
Prisoners Point	PRI	63,752	76,161	63,508	76,023	19%	20%	-75,810	-93,745	-76,659	-94,445	-24%	-23%
Rio Vista	RSAC1 01	123,000	124,759	123,250	124,850	1%	1%	-117,176	-118,385	-117,278	-118,495	-1%	-1%
Middle River @ Middle River	RMID0 15	12,094	10,096	11,825	9,905	-17%	-16%	-17,765	-28,909	-18,260	-30,332	-63%	-66%
Cache Slough @ Ryer Island	RYI	91,733	92,335	91,983	92,434	1%	0%	-95,054	-95,768	-95,086	-95,780	-1%	-1%
San Andreas	SAN	118,136	115,591	117,805	115,133	-2%	-2%	-127,245	-124,669	-128,071	-125,525	2%	2%
Threemile Slough	SLTR M004	28,298	27,172	28,204	27,041	-4%	-4%	-34,411	-32,817	-34,666	-32,905	5%	5%
Turner Cut	TRC	2,640	3,400	2,586	3,318	29%	28%	-3,758	-6,276	-3,805	-6,454	-67%	-70%
Victoria Canal	VIC	2,908	2,626	2,616	2,332	-10%	-11%	-6,172	-6,715	-6,815	-8,119	-9%	-19%

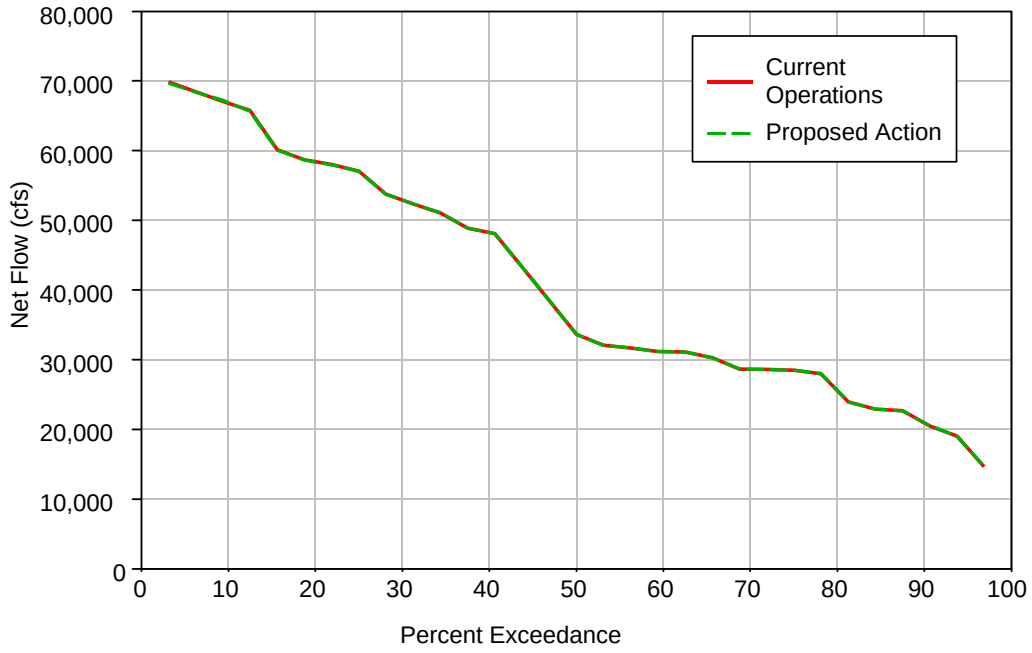


Figure 3.9-20 Net Flow Exceedence for Current Operations and Proposed Action at Chipps Island for January 2004

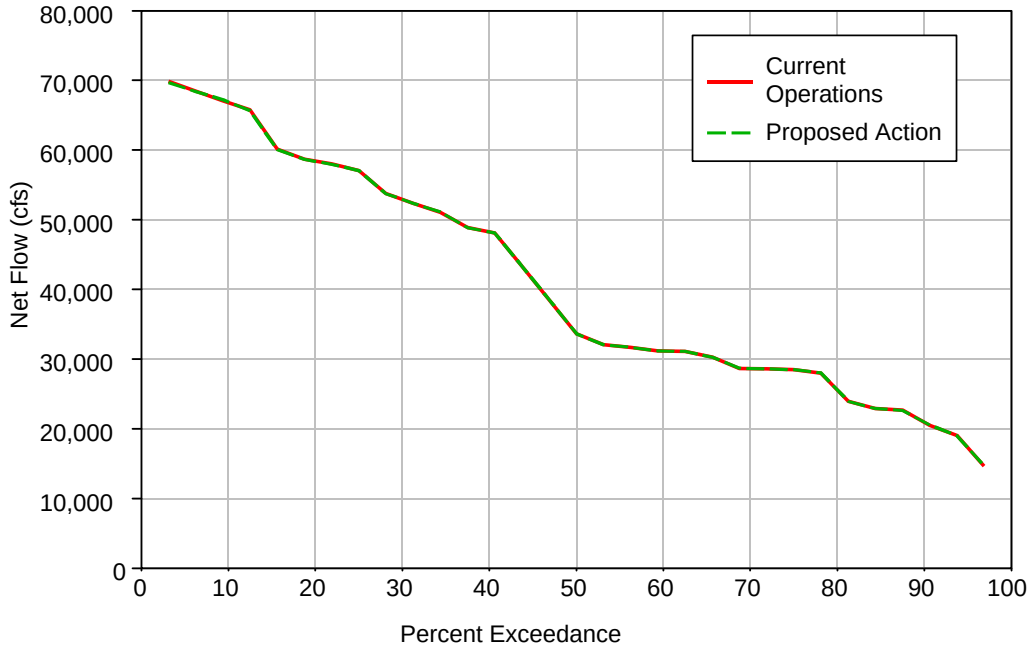


Figure 3.9-21 Net Flow Exceedence for Current Operations and Proposed Action at MID (Middle River South of Woodward Canal) for January 2004 (Adult Period)

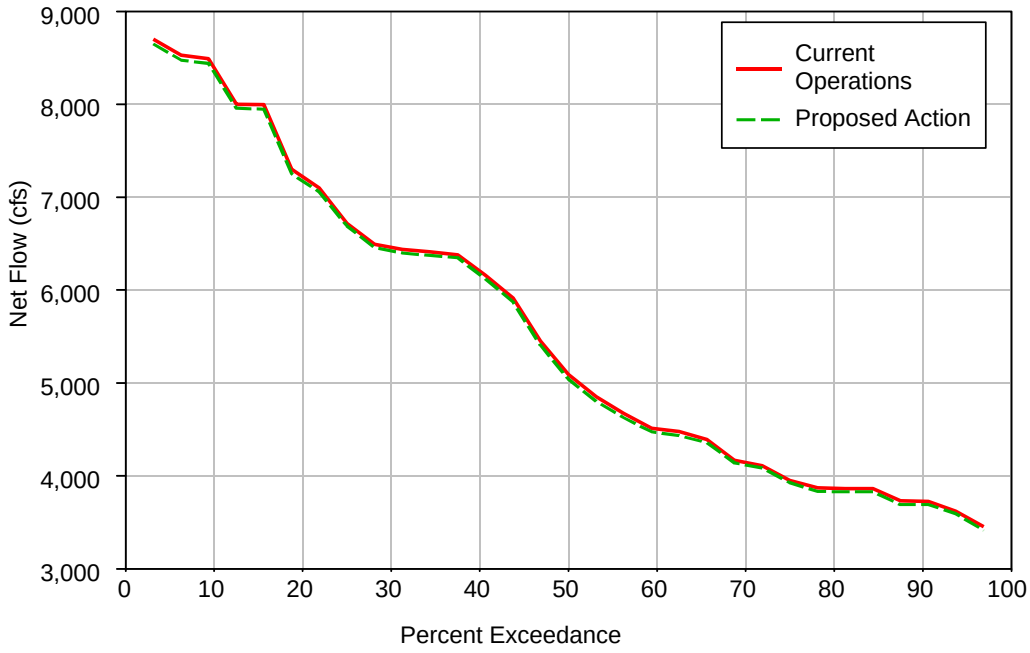


Figure 3.9-22 Net Flow Exceedence for Current Operations and Proposed Action at MOK (Mokelumne River at San Joaquin River) for January 2004

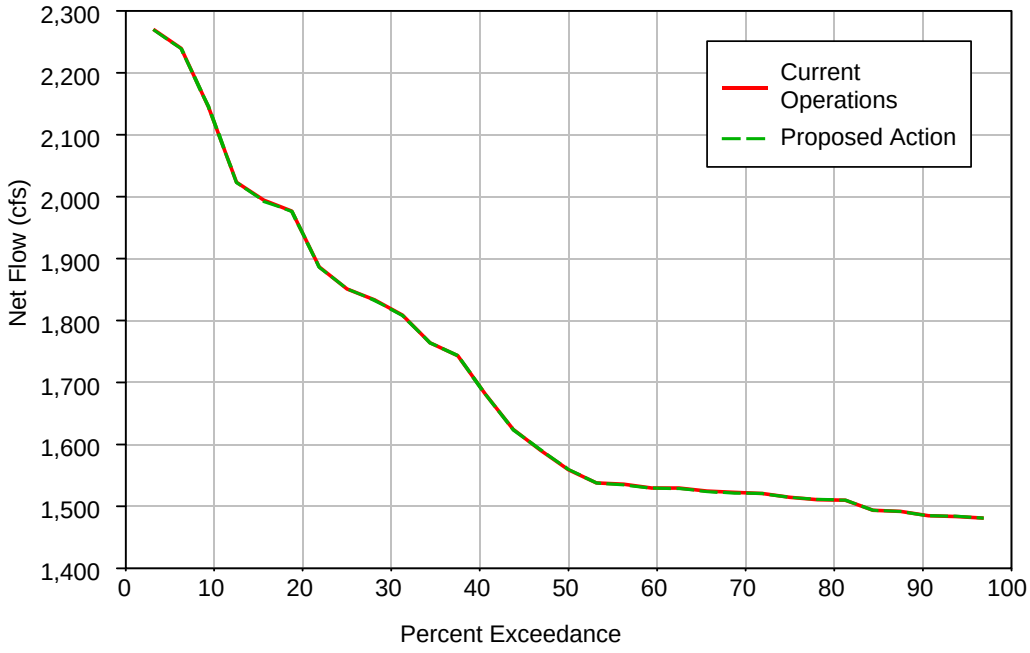


Figure 3.9-23 Net Flow Exceedence for Current Operations and Proposed Action at MOS (RSAN087, San Joaquin River at Mossdale) for January 2004

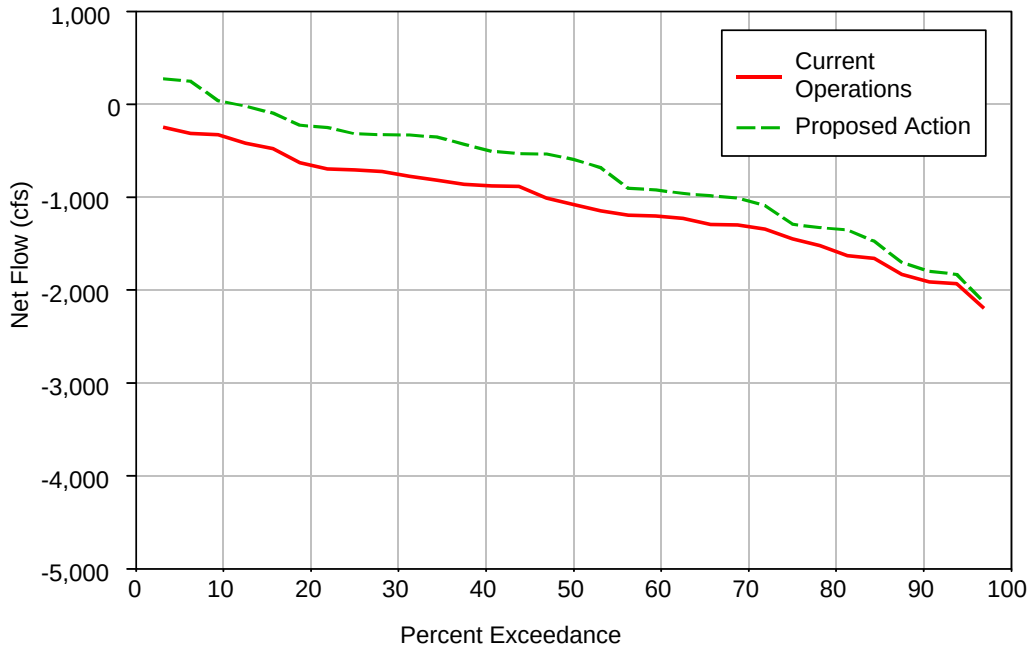


Figure 3.9-24 Net Flow Exceedence for Current Operations and Proposed Action at MRC (Middle River at Medford Island) for January 2004

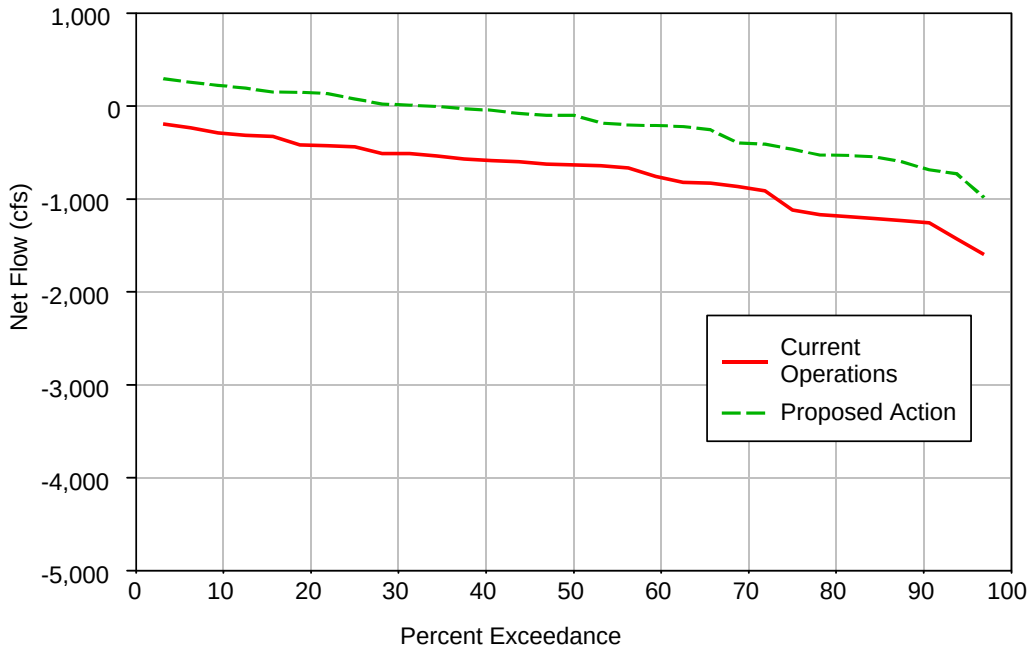


Figure 3.9-25 Net Flow Exceedence for Current Operations and Proposed Action at OLD (ROLD024, Old River at Bacon Island) for January 2004

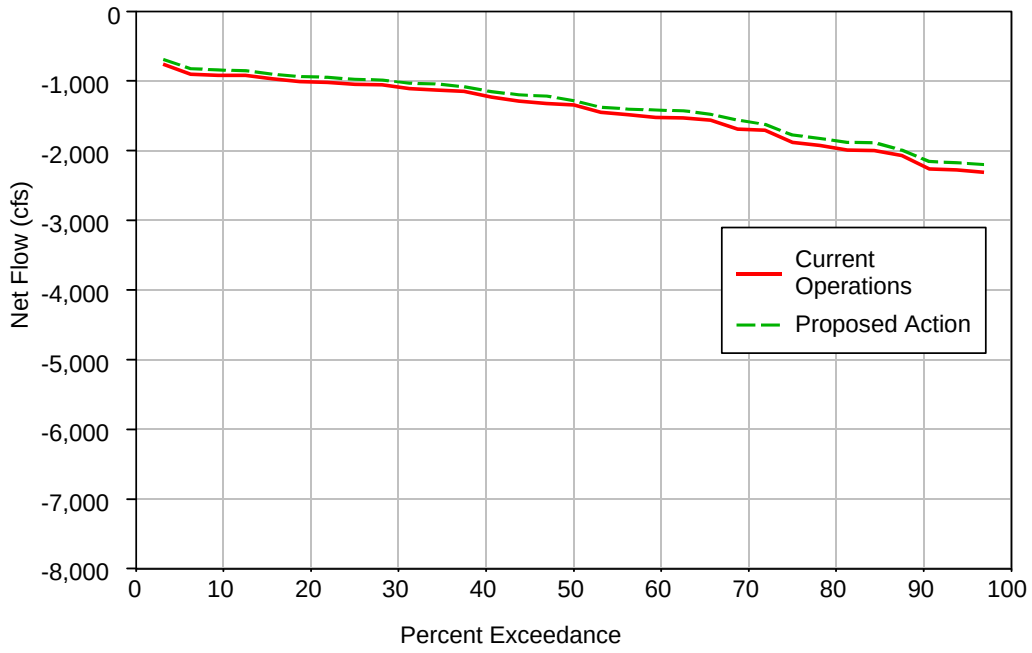


Figure 3.9-26 Net Flow Exceedence for Current Operations and Proposed Action at OLF (ROLD034, Old River near Byron) for January 2004

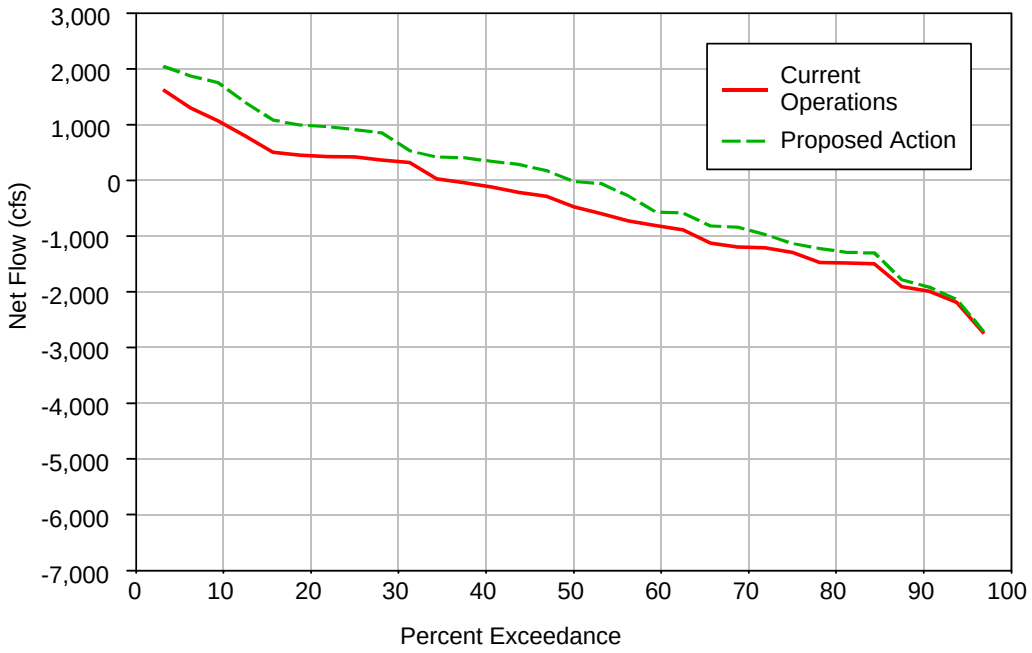


Figure 3.9-27 Net Flow Exceedence for Current Operations and Proposed Action at PRI (Prisoners Point) for January 2004

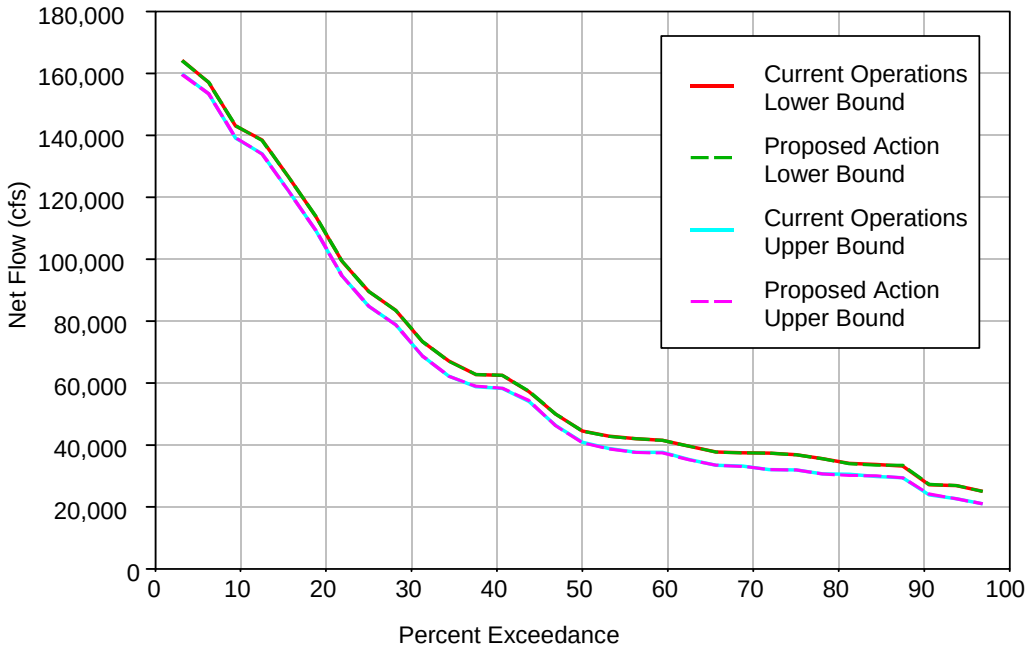


Figure 3.9-28 Net Flow Exceedence for Current Operations and Proposed Action at Chipps Island for March 2004

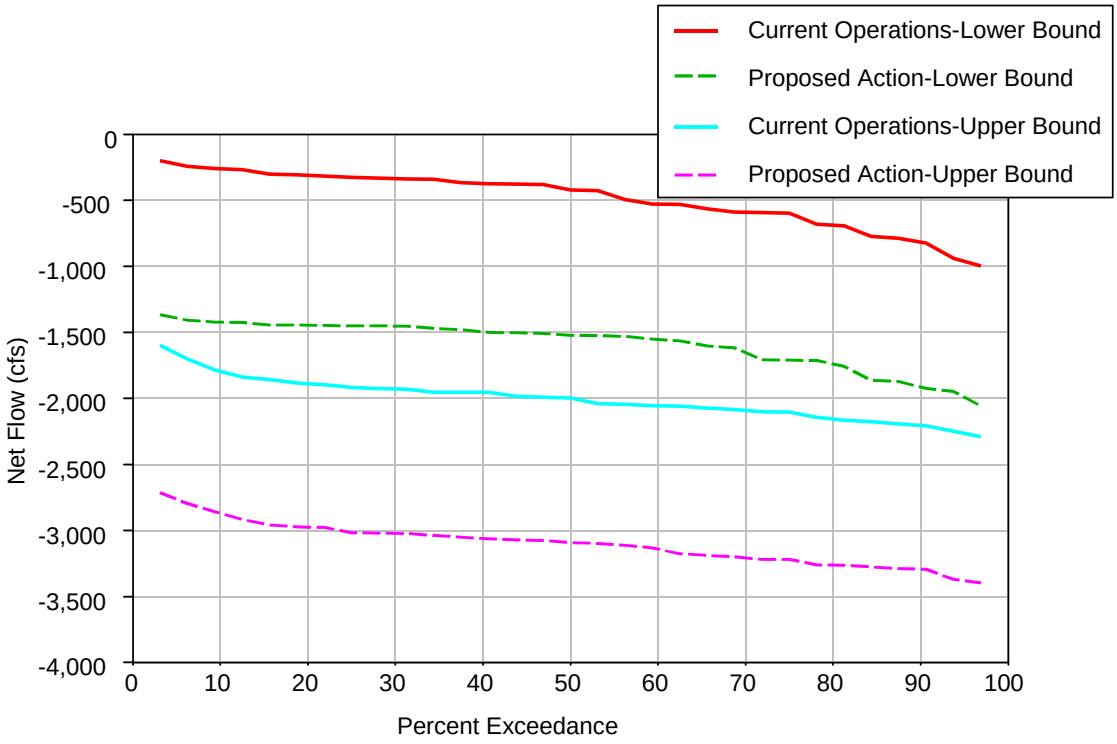


Figure 3.9-29 Net Flow Exceedence for Current Operations and Proposed Action at MID (Middle River South of Woodward Canal) for March 2004

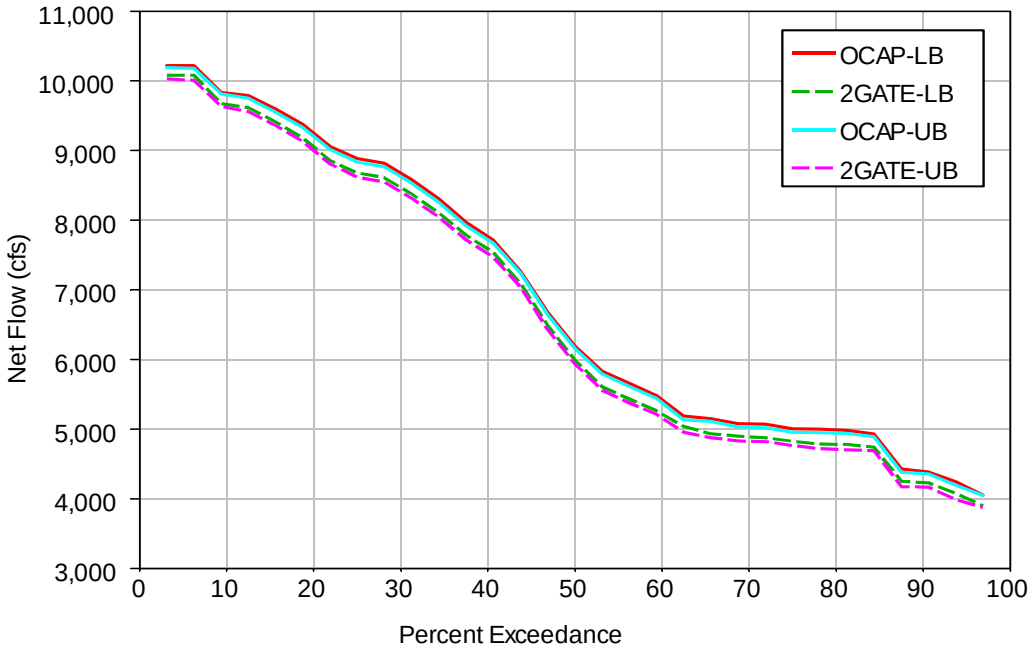


Figure 3.9-30 Net Flow Exceedence for Current Operations and Proposed Action at MOK (Mokelumne River at San Joaquin River) for March 2004

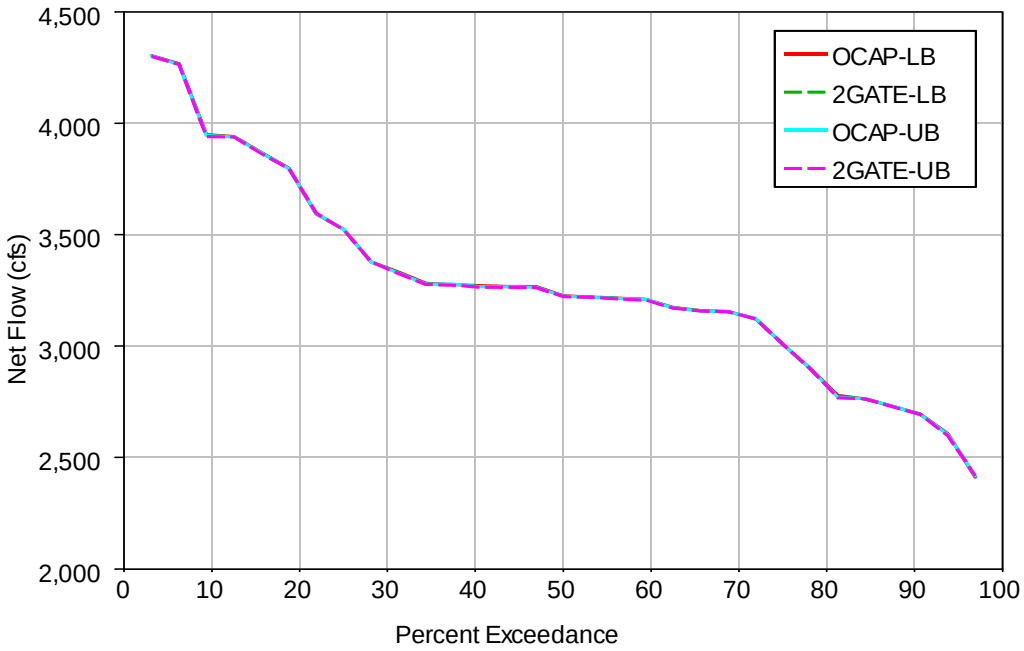


Figure 3.9-31 Net Flow Exceedence for Current Operations and Proposed Action at MOS (RSAN087, San Joaquin River at Mossdale) for March 2004

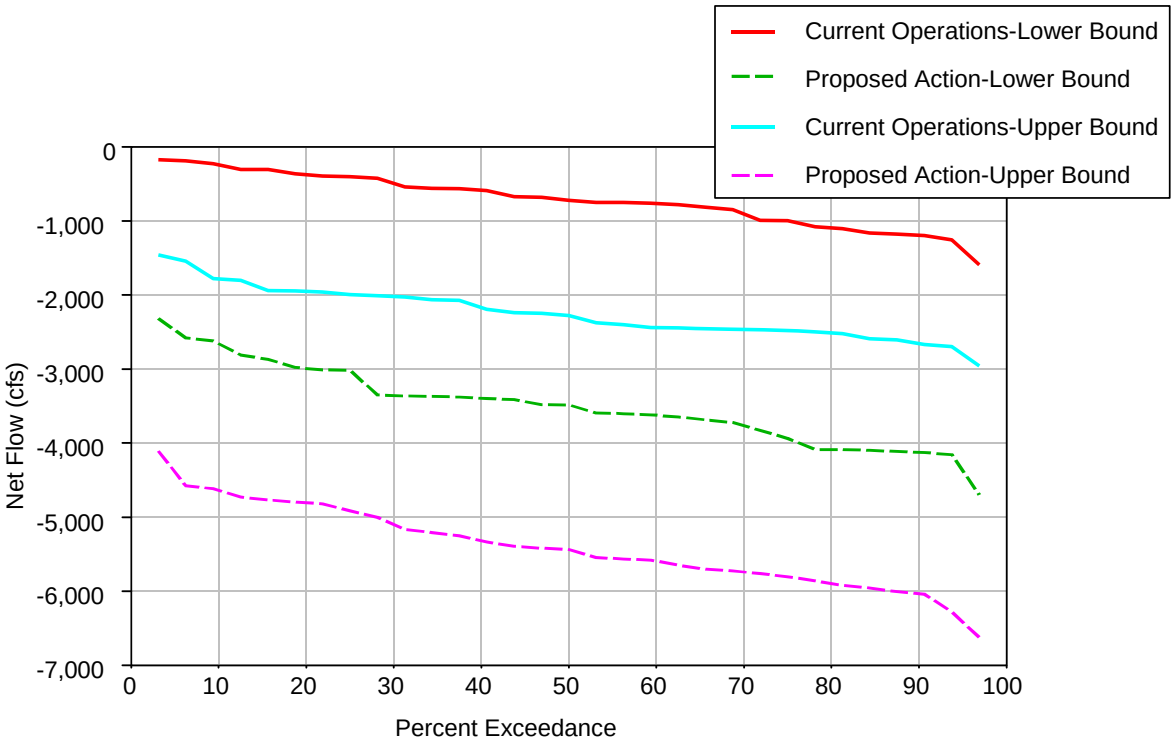


Figure 3.9-32 Net Flow Exceedence for Current Operations and Proposed Action at MRC (Middle River at Medford Island) for March 2004

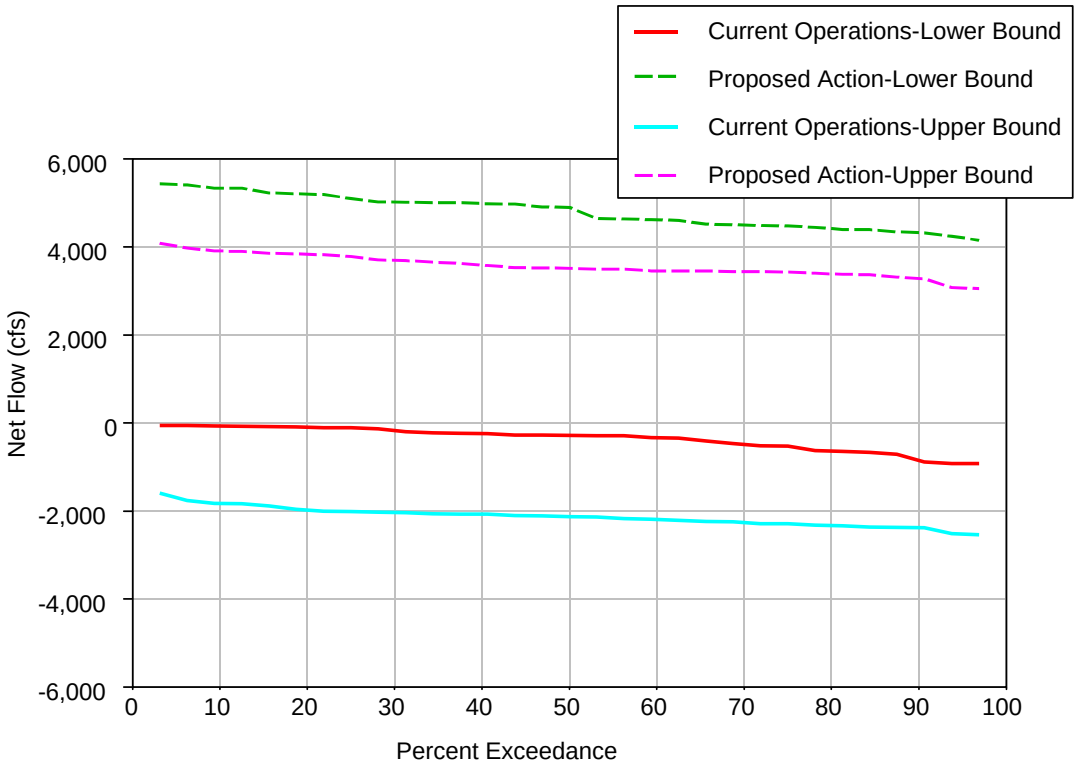


Figure 3.9-33 Net Flow Exceedence for Current Operations and Proposed Action at OLD (ROLD024, Old River at Bacon Island) for March 2004

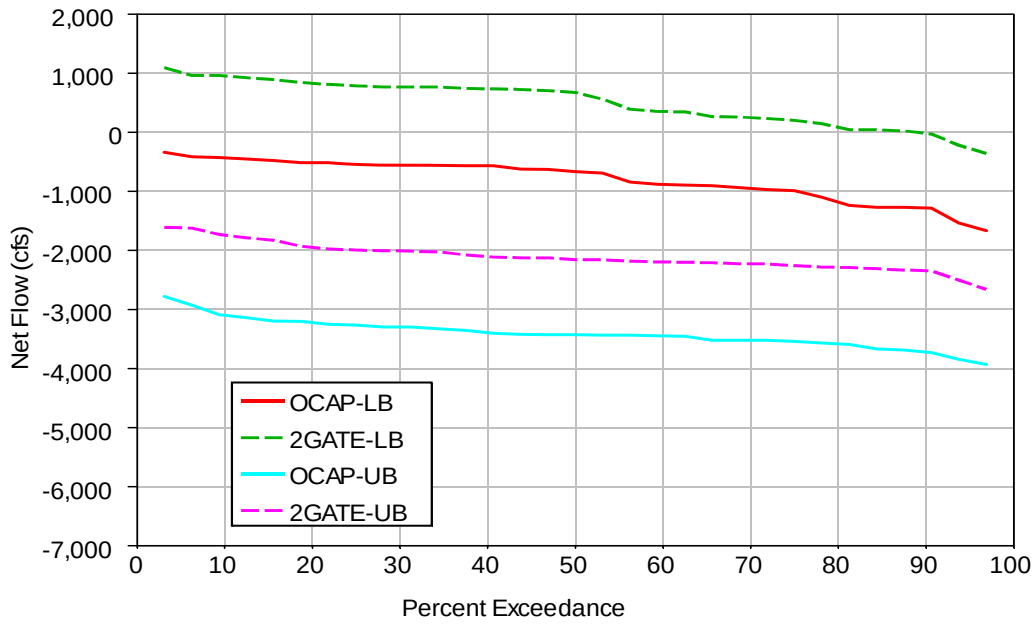


Figure 3.9-34 Net Flow Exceedence for Current Operations and Proposed Action at OLF (ROLD034, Old River near Byron) for March 2004

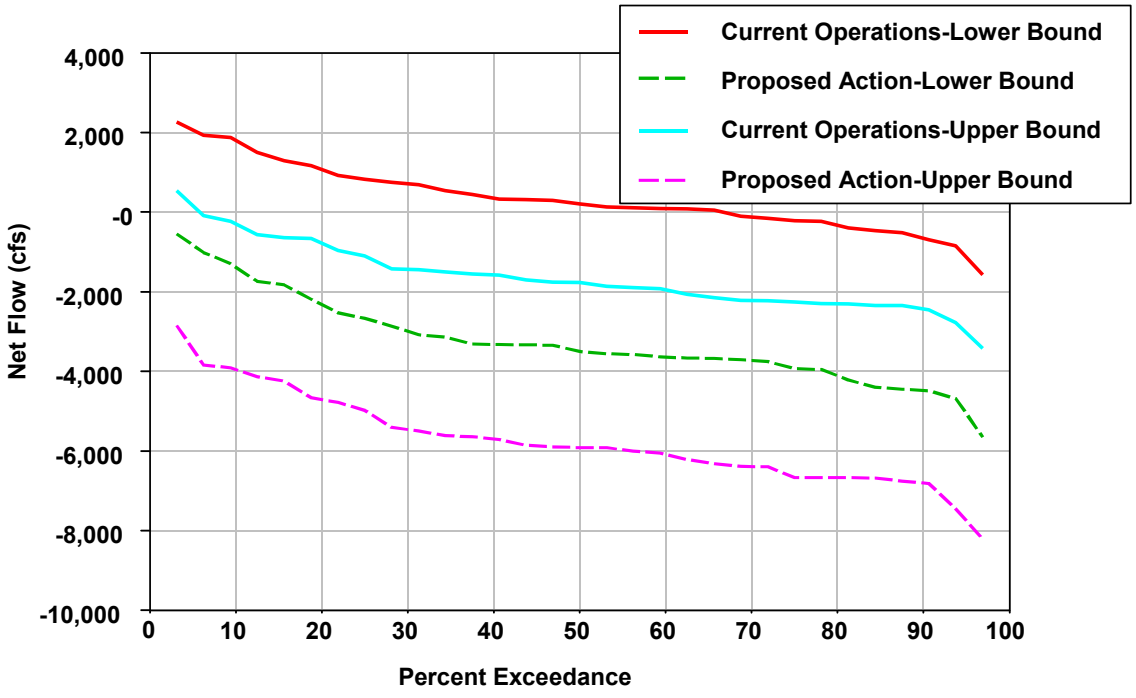


Figure 3.9-35 Net Flow Exceedence for Current Operations and Proposed Action at PRI (Prisoners Point) for March 2004

Erosion and Sedimentation. Surface water flow rates near the Old River and Connection Slough sites would be modified by the installation of the sheet piles and gates. Detailed analyses of near-field hydrodynamic effects with gates in their open position were performed by Moffatt & Nichol using the MIKE 11 and 21 hydrodynamic models (details are included in Appendix J, Near-Field Hydrodynamic Analyses). These analyses also included modeled effects in a larger area, including areas surrounding the channel islands in Old River. The simulations provide data for surface water conditions on the ebb and flood tides during peak flows. The model results indicate that effects of the Proposed Action would not exceed erosion and deposition thresholds established for the Delta by DWR. In two major flood events (January 1993 and January-February 1997), the results show concentrated flows greater than 4 ft/sec near gates in center of the channel, but channel-averaged velocities less than 3 ft/sec at these same locations. These conditions showed concentrated flows near channel banks of the study area of 0.5 - 1.5 ft/sec; and concentrated flows of 0.5 - 2.0 ft/sec at the nearby channel islands of the study area. Existing flow velocities in these regions are generally less than 2 ft/sec. It is important to note that the January 1993 and January-February 1997 events were large magnitude events, and that normal large ebb tides would produce velocities less than those described above.

Figure 3.9-36 shows the peak water velocity on flood tides and high watershed runoff conditions in the Old River channel with the gates open. This specific condition would be expected to occur approximately 2 hours per year. Peak flow rates through the constricted opening would be approximately 5 feet/second. This flow rate would decrease to approximately that of the existing conditions before reaching the in-channel island and eastern trending oxbow north of Rock Slough. Calm areas would be presented immediately upstream and downstream of the facilities near the shore. Low velocity downstream flows would occur upstream of the project facilities. Figure 3.9-37 shows the peak water velocity on ebb tides in the Old River channel with the gates open but other project facilities installed. Peak flow rates through the constricted opening would not exceed 4 ft/sec. This flow rate would decrease to approximately 2.0 to 2.5 ft/sec approximately 1,000 feet downstream of the gates, before reaching the in-channel island north of the project facilities and Holland Cut. Calm areas would be presented immediately upstream and downstream of the facilities near the shore. Low velocity upstream flows would occur upstream of the project facilities.

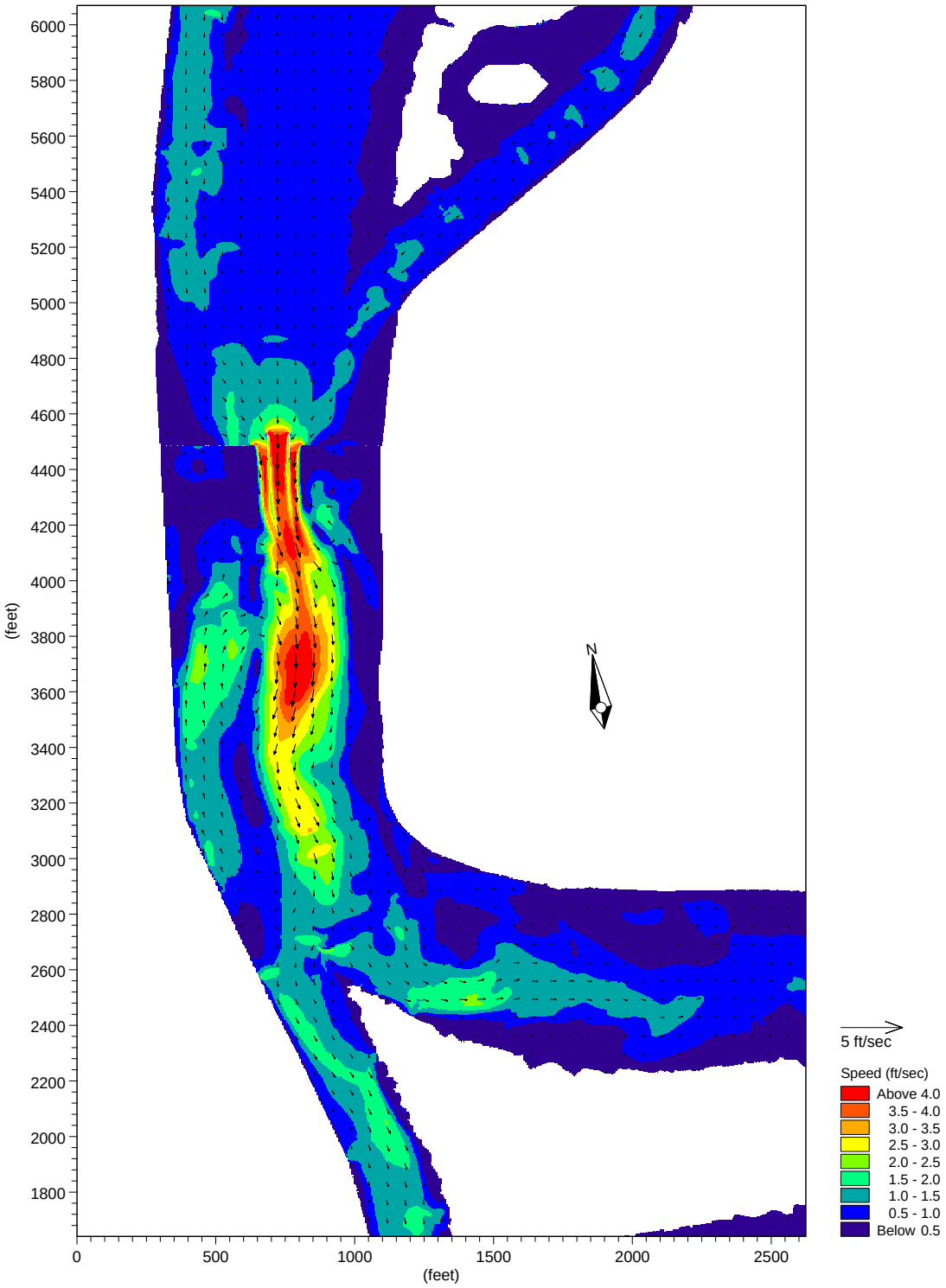


Figure 3.9-36 Peak Water Velocity for Flood Tides with the Proposed Action at Old River (January 13, 1993)

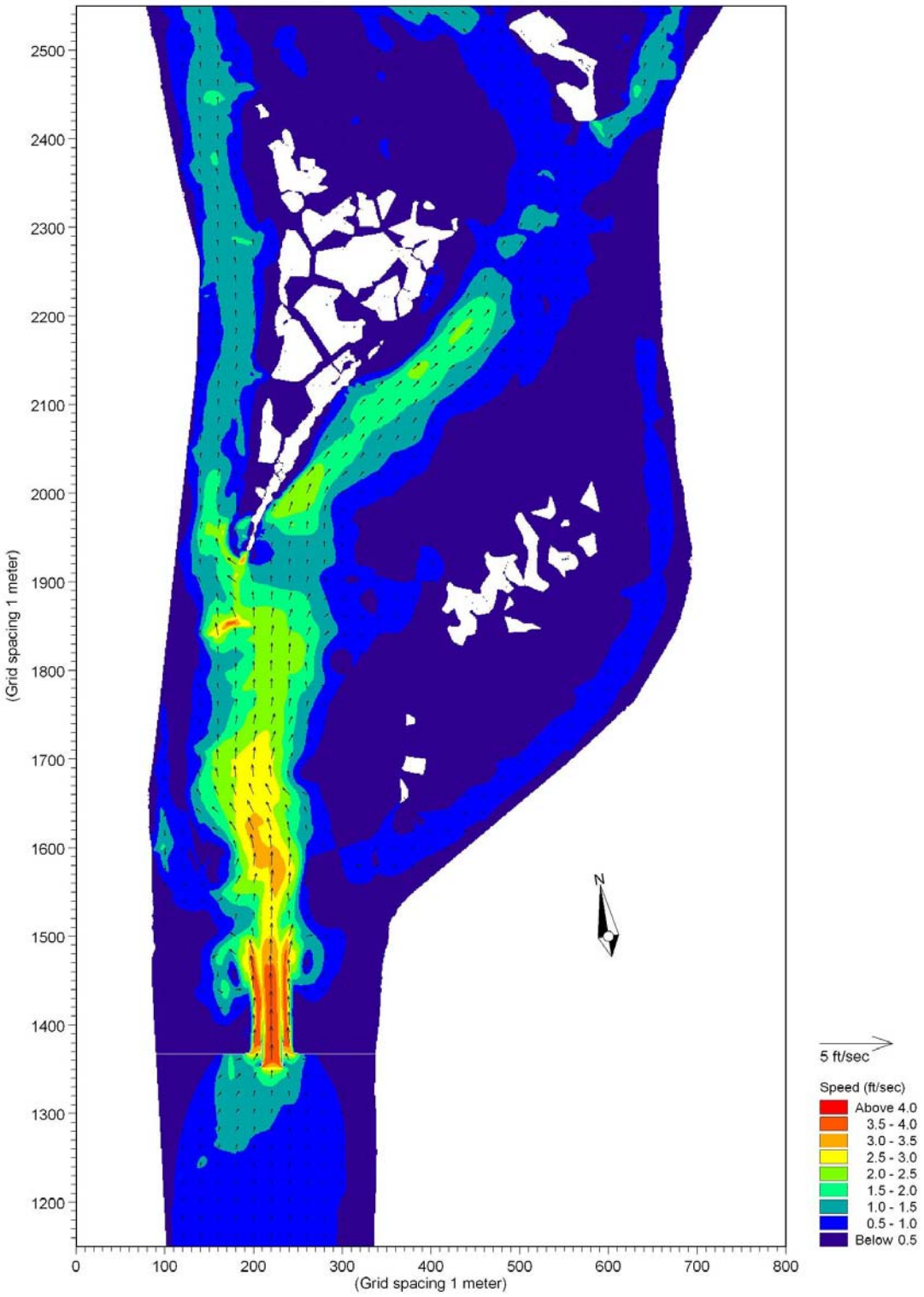


Figure 3.9-37 Peak Water Velocity for Ebb Tides with the Proposed Action at Old River (January 6, 1997)

Change in Water Level. When the gates were closed, the Proposed Action would alter the water surface elevation in some portions of the Delta region. Based on the simulation model described in Appendix A, this effect would be most notable when the gates were closed to protect juvenile and larval delta smelt (generally, in parts of March and June). Changes in water surface elevation in December through portions of March when the Proposed Action is operated for the protection of adult delta smelt would be much less since the gates would be open for much of the time. The expected changes in mean high water are shown in Table 3.9-6 (also see Figures 3.5-6 and 3.5-7). The greatest increase in water surface elevation would be found in Delta channels immediately downstream from the proposed Old River and Connection Slough facilities. These changes in mean high water surface elevation would range from no change to approximately 2 inches. The greatest decrease in water surface elevation would be found in channels immediately upstream from the Proposed Action facilities. These changes in mean high water surface elevation would range from approximately 2 to 13 inches. When the gates were open, the Proposed Action would have a negligible effect on Delta hydrology and water quality.

Location		Mean High Water Stage (inches)			
Channel	Near	March		June	
		Lower Bound	Upper Bound	Lower Bound	Upper bound
Sacramento River	Rio Vista	0	0	0	0
Sacramento River	Sherman Island	0	0	0	0
Sacramento River	Walnut Grove	0	0	1	1
San Joaquin River	Antioch	1	1	1	1
San Joaquin River	Jersey Island	1	1	1	1
San Joaquin River	Threemile Slough	1	1	1	1
San Joaquin River	Mokelumne River	1	1	1	1
San Joaquin River	Old River	1	1	1	1
San Joaquin River	Medford Island	1	1	1	1
San Joaquin River	Turner Cut	1	1	1	1
San Joaquin River	Middle Roberts Island	1	0	0	1
San Joaquin River	Upper Roberts Island	0	-1	0	0
San Joaquin River	Old River	-1	-1	-2	-2
San Joaquin River	Vernalis	-1	-1	-2	-2
Old River	Franks Tract	1	1	1	1
Old River	Rock Slough	-10	-13	-9	-11
Old River	SR 4	-9	-12	-9	-11
Old River	Victoria Island	-8	-10	-8	-10
Old River	Clifton Court	-7	-7	-8	-10
Old River	Tracy Pumping Plant	-6	-7	-5	-5
Old River	Fabian Tract	-6	-6	-5	-5
Middle River	Columbia Cut	0	0	0	0
Middle River	Lower Jones Tract	-2	-2	-2	-3
Middle River	Victoria Island	-6	-6	-7	-7
Middle River	Middle Roberts Island	-5	-6	-6	-6
Middle River	Upper Roberts Island	-6	-7	-6	-6
Middle River	San Joaquin River	-2	-2	-3	-3
Victoria Canal		-8	-8	-8	-9
Grant Line Canal		-7	-7	-8	-10
Mokelumne River	North Fork	1	1	1	1
No. Mokelumne River	Steamboat Slough	1	1	1	1
So. Mokelumne River	Terminous	1	1	1	1

Table 3.9-6 Change in mean high water (inches) with the implementation of the Proposed Action

Flooding. Although the 2-Gates facilities would occasionally alter the existing hydrology of two specific stream channels in the Delta, the facilities have been designed to avoid the substantial modification of hydrology under high flow (flood) conditions from the Sacramento and San Joaquin River watersheds. As a fundamental operational criterion, the gates would be

kept open during the high-flow conditions to permit the passage of the flood flows. This would restore much of the pre-Project channel capacity of the Old River and Connection Slough.

DSM2 was used to model the peak flood event from February 1997 event, which was roughly a 100-year event. The stage hydrographs of the existing and "gates open" conditions for this flood event at the proposed barrier on Old River are compared in Figure 3.9-39. As the figure illustrates, the barrier would not increase the flood stage profile at the peak stages immediately upstream or downstream of the barrier.

The stage hydrographs of the existing and gates open conditions for the February 1998 flood event at gage location ROLD014 downstream of the barrier are compared in Figure 3.9-31. The stage hydrographs of the existing and gates open conditions for the February 1998 flood event at gage location ROLD024 upstream of the barrier are compared in Figure 3.9-41. Figures 3.9-40 and 3.9-39 confirm that the barrier would not increase the flood stage profile at the peak stages within a mile upstream or downstream of the barrier.

The exceedence probability expressed as a percent for river stage at the sites immediately upstream and downstream of the barrier is presented in Figure 3.9-40 for the Old River barrier. Lines are shown for the baseline condition, as well as gates open on the upstream side of the structure and gates open on the downstream side of the structure. The exceedence probability plots support the finding of no impact on flood stage greater than 8.4 feet North American Vertical Datum of 1988 (NAVD88) due to the Project barrier. These results include an inherent conservatism in the analysis due to lack of overtopping of the barrier that would normally occur for flood stages greater than 6.6 feet NAVD88. The 100-year flood stage within Old River is 9.71 feet NAVD88.

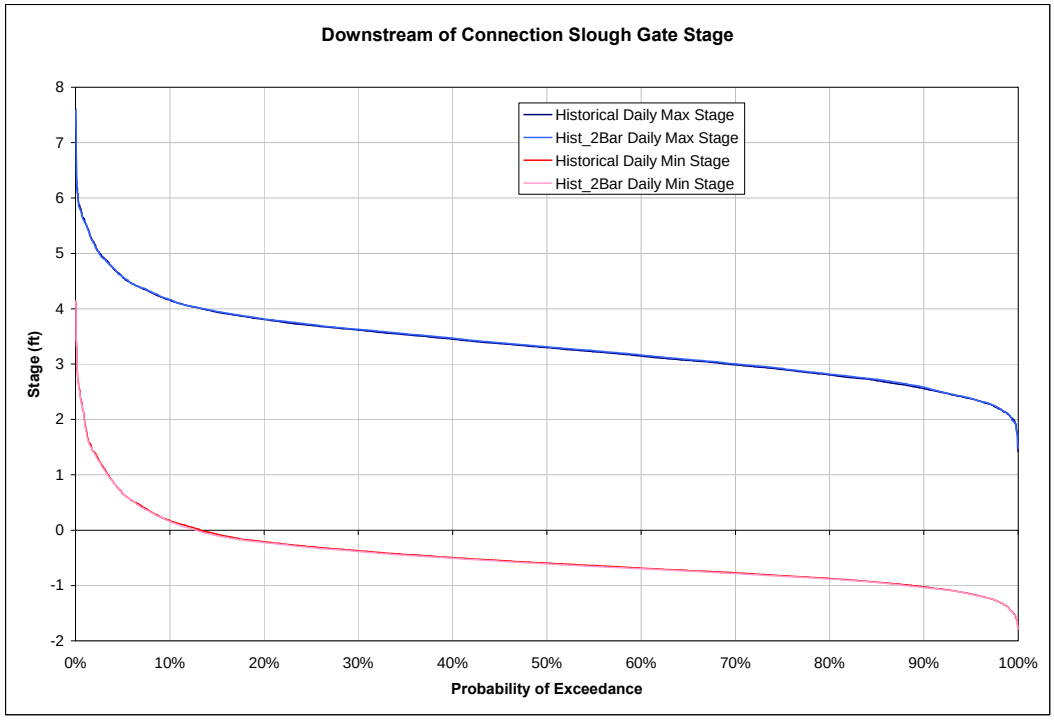


Figure 3.9-38 Change in Low and High Tide Water Surface Elevation near 2-Gates Facilities

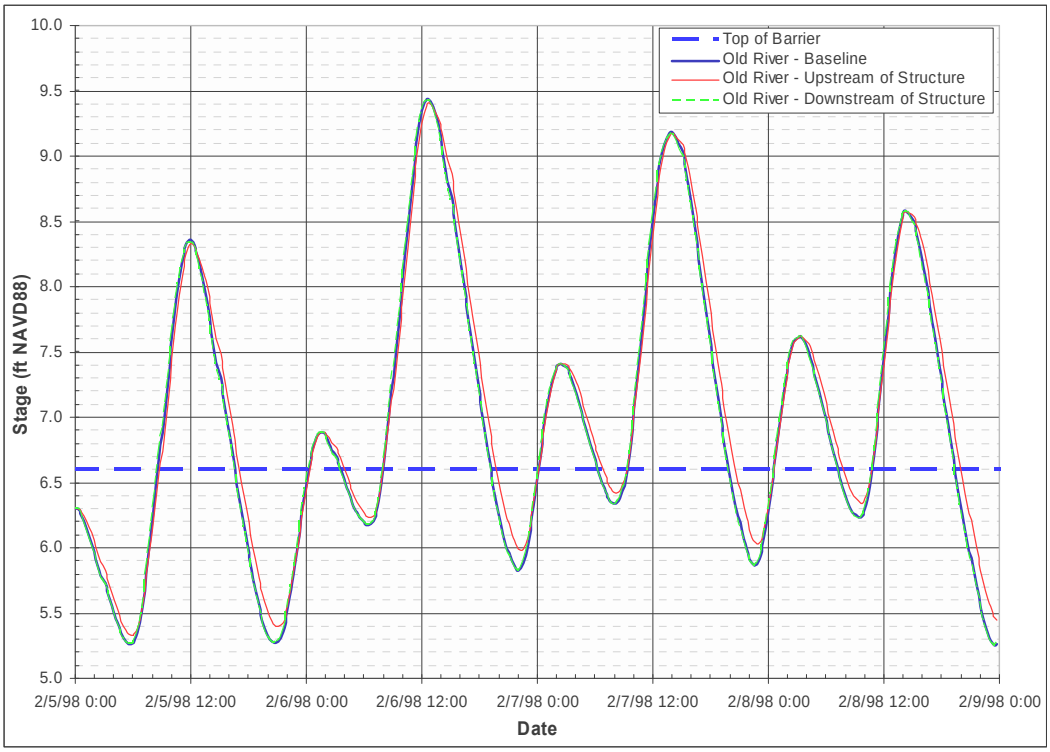


Figure 3.9-39 Stage Profiles for February 1997 Flood Event at Old River—2-Gates Barrier

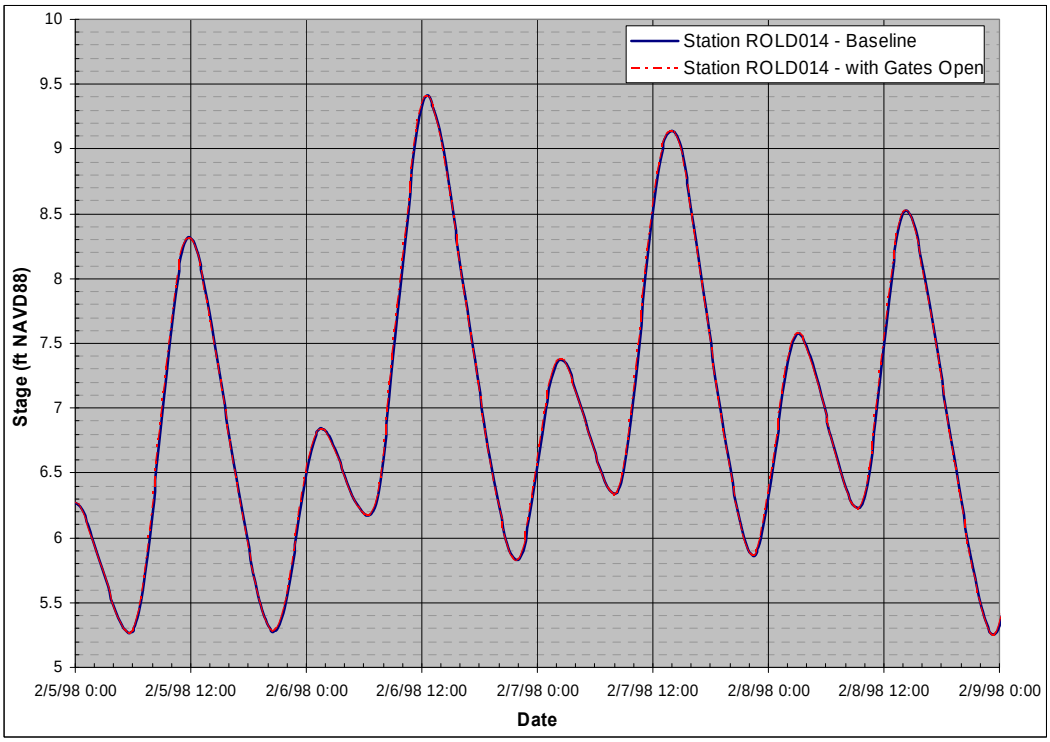


Figure 3.9-40 Stage Profiles for February 1998 Flood Event at Old River Gage Station ROLD014

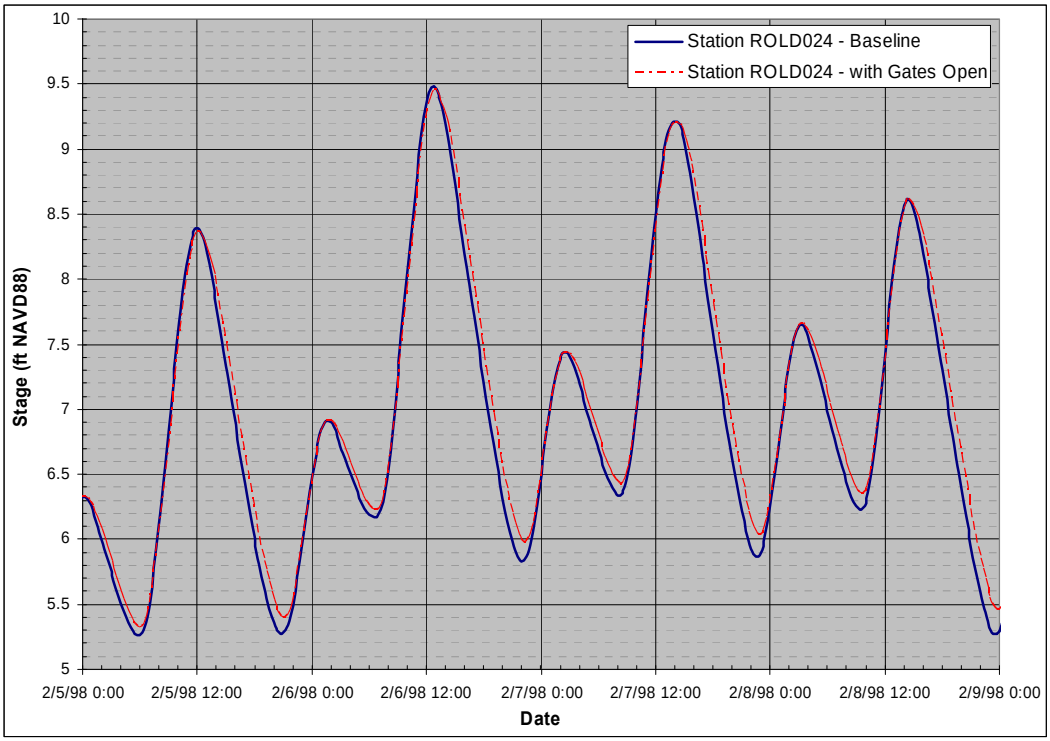


Figure 3.9-41 Stage Profiles for February 1998 Flood Event at Old River Gage Station ROLD024

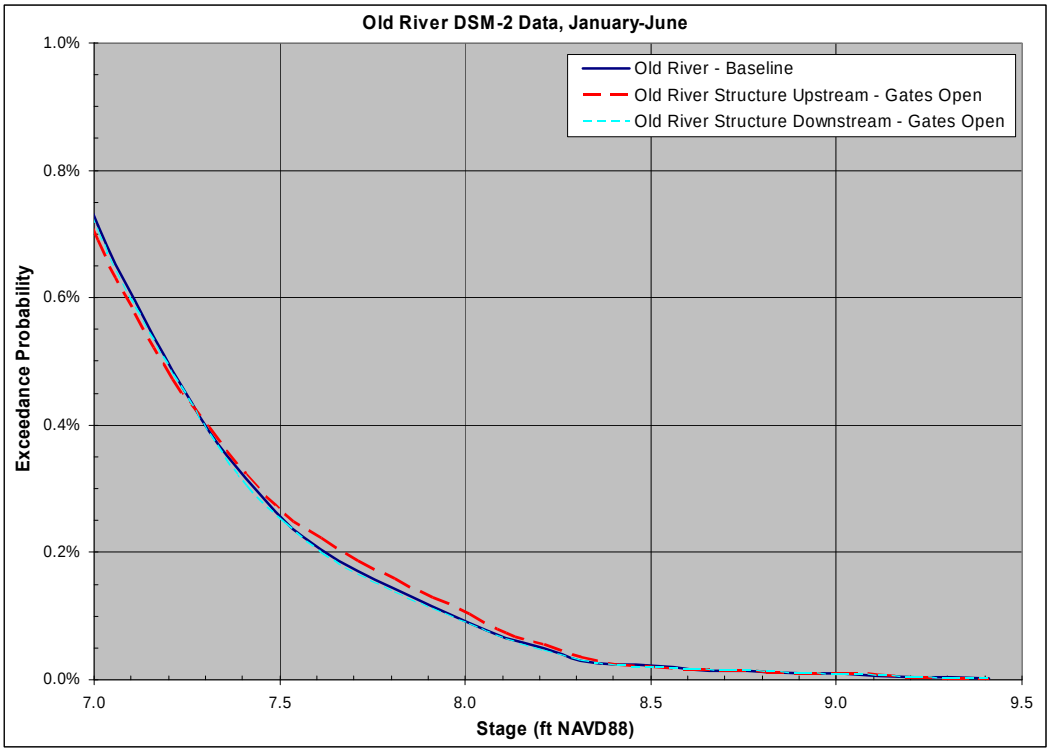


Figure 3.9-42 Exceedence Probabilities for High Stages at Old River—2-Gates Barrier

Additionally, Proposed Action facilities, especially the sheet pile materials connecting the barriers to the existing levee system, are designed to preclude adversely affecting the existing levee system. This design consideration further minimizes the potential to adversely affect off-site flooding. Refer to Appendices L and M for additional detail regarding flooding.

Water Quality

Depending upon the duration of the gates closure, weather, and initial water quality conditions, the proposed operations could result in changes in water quality similar to those found in other dead-end sloughs of the Delta. When the gates are closed, small portions of channels adjacent to the Old River and Connection Slough barriers would likely receive reduced mixing, which may result in slightly degraded water quality including slightly reduced oxygen, minor changes in salinity, and may have a tendency to allow for the development of patches of aquatic plants and temporarily trap floating debris. This effect would be temporary and would not be as pronounced as conditions in permanent dead-end sloughs because operations of the Proposed Action are anticipated to include a relatively short closure periods (up to approximately two hours per day), the gates would not be completely sealed, and some small flow volumes would move past the gates. These conditions would dissipate soon after the gates were opened. These changes would be most pronounced when ambient air temperature is high, winds speeds are low, and tidal action is small. Therefore, changes to water quality from gate closures would be small.

When the gates were open and extreme tidal actions occurred, increased water velocities near the gates could result in localized sediment mobilization and the potential for channel bottom erosion. As described in Environmental Commitment HYDRO-1 (Section 2), this effect would

be monitored, and r***emedial actions would be implemented should observable sediment transport be detected; thus, operations*** would result in minimal effects on channel sediments.

Due to its proximity to the Proposed Action facilities, changes in salinity could occur at the compliance location at Rock Slough specified under D-1641. Simulations of the Proposed Action operations conducted using DSM2 indicate that operation of the Proposed Action would not to lead to violations of the Rock Slough standard, although there were instances (winter) when salinity was increased by a small amount compared to existing conditions at Rock Slough (Figure 3.9-43). Installation of barriers and closure of the gates would generally improve water quality at Rock Slough by reducing salinity intrusion. During the periods of operation, gate closure would slightly reduce local flushing, which could lead to a slight degradation of water quality at Rock Slough. This would only be a significant concern if Contra Costa Water District (CCWD) operations required significant flow from Rock Slough.

No other water quality impacts have been identified. However, the Proposed Action would include local and regional water quality monitoring to support all testing and adaptive management of the facilities. Water quality monitoring would be conducted at a series of compliance points and at municipal and agricultural water diversion intakes to identify if changes in water quality occur that are associated with Project operations. If these data identify water quality effects associated with the Proposed Action, adjustments to operation criteria would be implemented to minimize salinity or other water quality effects at sensitive locations. Operational adjustments would primarily involve changes to timing and duration of gate opening.

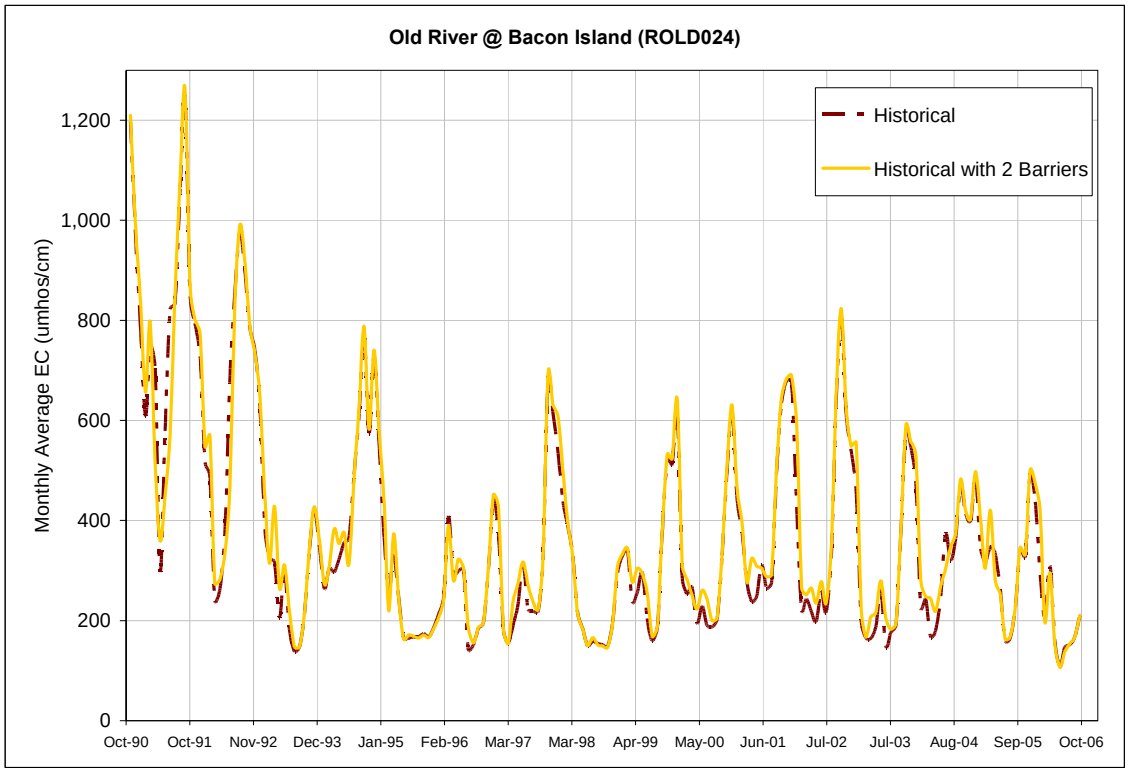


Figure 3.9-43 Projected Salinity near the CCWD Rock Slough Water Diversion Location

Groundwater

The Proposed Action would only contact the uppermost portion of groundwater-bearing formations as a result of dredging to approximately 35 feet below sea level and would have no effect on local or regional groundwater hydrology or groundwater water quality. The Proposed Action would not increase the use of groundwater, nor would it interfere with natural groundwater recharge because no impermeable surfaces would be created on land.

3.10 Noise

This section addresses potential noise impacts on humans. Impacts on wildlife and fish are addressed in Sections 3.4 and 3.5, respectively. Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. Several noise measurement scales are used to describe noise in a particular location. A decibel (dB) is a unit of measurement that indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 dB represents a 10-fold increase in acoustic energy, while 20 dB is 100 times more intense, 30 dB is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10-dB increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities.

There are several methods of characterizing sound. The most common is the A-weighted sound level, or dBA. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

Because the sensitivity to noise increases during the evening and at night—excessive noise interferes with the ability to sleep—24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The Community Noise Equivalent Level (CNEL) is a measure of the cumulative noise exposure in a community, with a 5-dB penalty added to evening (7:00 p.m. to 10:00 p.m.) and a 10-dB addition to nocturnal (10:00 p.m. to 7:00 a.m.) noise levels. The Day/Night Average Sound Level (L_{dn}) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this 3-hour period are grouped into the daytime period.

3.10.1 Affected Environment

The Old River and Connection Slough sites are located in a remote rural area. Primary sources of noise are agricultural activities on adjacent farmlands, although the use of power boats also would cause periodic noise increases. The EPA has indicated that background noise levels are generally near 44 to 45 dBA L_{dn} in agricultural cropland (EPA 1978). Some land uses are generally regarded as being more sensitive to noise than others due to the types of population groups or activities involved. Single- or multiple-family residences, schools, hospitals, churches,

and public libraries are typically considered to be noise-sensitive receptors. The nearest known sensitive receptors are a residence and bunkhouse located approximately 0.42 mile northwest of the Connection Slough site (north of the bridge) and liveaboards at the marina located approximately 0.8 mile south of the Old River site. The Roberts Island #1 disposal site also is located in an agricultural area, and the noise environment is dominated by vessels using the Stockton Deepwater Ship Channel.

3.10.2 Regulatory Setting

Noise is regulated at the local level through policies and standards included in the Noise Elements of the Contra Costa County (2005) and San Joaquin County (1992) General Plans. The Contra Costa County (2005) General Plan specifies that noise levels in agricultural areas are normally acceptable up to 75 dBA (L_{dn} or CNEL) and conditionally acceptable up to 80 dBA. Noise levels in residential areas are normally acceptable up to 60 dBA and conditionally acceptable up to 70 dBA (L_{dn} or CNEL). Policy 11-9 states that: "Construction activities shall be concentrated during the hours of the day that are not noise-sensitive for adjacent land uses and should be commissioned to occur during normal work hours of the day to provide relative quiet during the more sensitive evening and early morning periods" (Contra Costa County 2005).

The San Joaquin County (1992) General Plan Public Health and Safety Element, Section D, Noise indicates that the hourly equivalent sound level from stationary noise sources shall be 50 dB during the daytime and 45 dB during the nighttime for outdoor activity areas for residential development and that the maximum sound level from stationary sources shall be 70 dB during the nighttime at such areas (San Joaquin County 1992). These allowable levels are to be used for land use planning purposes and do not address construction noise. The San Joaquin County Code, Part 9-1025.9 also contains noise standards. The maximum allowable noise exposure at residential outdoor activity areas from stationary noise sources is 50 dB L_{eq} from 7 a.m. to 10 p.m. and 45 dB L_{eq} from 10 p.m. to 7 a.m. The maximum sound level (L_{max}) during these periods is 70 dB and 65 dB, respectively. The code exempts construction noise from the provisions of the noise chapter, as long as construction activities do not take place before 6 a.m. or after 9 p.m. on any day.

3.10.3 Affected Environment

3.10.3.1 No Action Alternative

The No Action alternative would not affect noise because no development would occur.

3.10.3.2 Proposed Action

The Proposed Action would generate noise primarily through the installation and removal of project facilities. The construction equipment and activities are those identified in Section 3.3, Air Quality. Impacts from the removal of project facilities would be similar to those from their installation, but would occur for a shorter duration.

Noise from a point source, such as a construction site, attenuates, or is reduced, by about 6 dBA for every doubling of the distance. Noise from most construction activities would attenuate to 59 dBA CNEL at the marina south of the Old River site. Use of an impact hammer to install the king piles would result in approximately 70 dBA CNEL; this could take place up to 12 hours a day during daytime hours. Construction noise would fall within the limits of what Contra Costa

County considers acceptable in residential locations and would comply with local requirements. Roberts Island #1 is an existing disposal site, and use of this site for the Proposed Action, if required, would not appreciably change the noise environment, particularly since a limited number of barge trips would be needed (between 5 and 20 roundtrips). Average noise levels from most construction activities would attenuate to about 58 CNEL at the residences northwest of Connection Slough; noise from the use of an impact hammer would result in approximately 98 CNEL in this area. Construction would occur during regular daytime hours and thus would comply with the requirements of the San Joaquin County Code.

A limited number of truck trips would be required during construction (a maximum of eight when certain materials were being delivered; most materials would be delivered by barge), and approximately 60 daily trips would be associated with the up to 30 construction workers. Delta Road, which would be used to access the Old River site, runs through an area containing scattered residential uses; Bacon Island Road traverses an area that is very sparsely populated. The limited number of truck trips and construction worker trips would not raise noise levels along the access roads in excess of local standards. Moreover, trips would be limited to daytime hours, which would further minimize the potential for impacts.

Boaters near the Old River and Connection Slough sites would be exposed to increased noise during construction. Exposure would be limited because boats would not be expected to linger in the immediate project area while construction occurred. Moreover, boating is not considered a noise-sensitive activity, particularly since most boats in the Delta are powerboats or would be under power while in the Old River and Connection Slough channels and are sources of noise in themselves.

The primary source of vibration would be pile driving in the channels during construction. The vibration pile driver typically results in an approximate vibration velocity level (velocity in decibels or VdB) of approximately 93 VdB at 25 feet (FTA 2006). Vibration attenuates very rapidly, and there are no sensitive receptors in the immediate vicinity of the Proposed Action. The nearest receptors are the residences on Mandeville Island, approximately 0.42 mile northwest of the Connection Slough Site, and live-aboard residents at the marina located approximately 0.8 mile from the Old River site; and they would not experience groundborne vibration or noise.

The Proposed Action would not create permanent noise sources. Two small diesel generators could be operated intermittently at the Old River and Connection Slough sites until PG&E power is available to provide electric power to the sites, and as an emergency power source. Noise emitted by the generators would attenuate to inaudible levels at the marina to the south of the Old River site and the residences on Mandeville Island. There are no noise-sensitive land uses near the Connection Slough site; therefore, noise emitted by project generators would not adversely affect noise-sensitive receptors.

3.11 Public Services

3.11.1 Affected Environment

This section focuses on fire and police protection because the Proposed Action would not result in population growth or otherwise affect schools, parks, or other public facilities.

3.11.1.1 Fire Protection

The Old River site is under the jurisdiction of the East Contra Costa Fire Protection District. The nearest fire station to the site is Station Number 58, located in Discovery Bay. However, the Marine Fire and Rescue Division operate out of two other stations, one on Bethel Island and the other in Knightsen. Twelve firefighters are assigned to these two stations and staff the 33-foot Fire Rescue Boat. In addition to the Fire Rescue Boat, the East Contra Costa Fire Protection District operates both Type I and Type III Fire Engines. Response time for a fire emergency is 6 minutes in most areas protected by the District (East Contra Costa Fire Protection District 2008). San Joaquin County also maintains a fire department in Isleton, located about 12 miles north of Connection Slough staffed by one career professional and 27 volunteers. Multiple stations also are located in Stockton.

3.11.1.2 Police Protection

The Old River and Connection Slough sites are under the jurisdiction of both the San Joaquin County and Contra Costa County Sheriff's Departments. The San Joaquin Sheriff Department Boating Safety Unit is the nearest unit that would respond to an emergency at these sites. This six-person unit is responsible for surveying over 700 miles of rivers and waterway in the Delta and is stationed at West Buckley Cove in Stockton, approximately 9 miles east of the Connection Slough site (actual miles traveled would be greater due to turns in river channels). Regular patrol units of the San Joaquin Sheriff Department operate out of the main station in French Camp (about 16 miles east of Connection Slough) and consist of 124 deputies divided between 8 patrol teams which patrol the county 24 hours a day, 7 days a week (San Joaquin County 2008). The Contra Costa County Sheriff Department Marine Patrol is responsible for patrolling over 200 miles of linear coastline from Richmond to Discovery Bay. The nearest Marine Patrol station to the project area is the Delta Station located in Oakley, approximately 7 miles northwest of the Old River site (Contra Costa County 2008).

3.11.2 Regulatory Setting

No federal or state regulations are applicable to police or fire protection associated with the Proposed Action. Both Contra Costa and San Joaquin counties establish appropriate service ratios.

3.11.3 Environmental Consequences

3.11.3.1 No Action Alternative

The No Action alternative would have no impacts on public services because no development would occur.

3.11.3.2 Proposed Action

The Proposed Action could result in increased demand for fire and police services during construction and operations in the event of accidents requiring emergency response. Such a

demand is typical of all construction activities and would be within the capabilities of the local and regional emergency response providers. Operation of the gates would not pose a particular risk, and no increased staffing of police or fire departments would be required. As discussed in Section 2, the marine patrols would be granted 24-hour access through the gates, and it would not be necessary to construct new emergency response facilities as a result of the Proposed Action.

3.12 Recreation

3.12.1 Affected Environment

The Delta provides a wide variety of public recreational opportunities, including motorized boating, fishing, camping, sailing, hunting, windsurfing, and waterskiing. The Delta accommodated approximately 6.5 million user days in 2000, while visitation is projected to increase to about 8 million user days in 2020 (Cal Boating 2002). This section focuses on recreational boating because it is the only recreational resource that would be affected by the Proposed Action. A statewide survey of registered boat owners found that 30 to 40 percent of boaters who visit the Delta recreate in the winter months, compared to over 80 percent in the summer. Roughly two-thirds of those interviewed recreated in the Delta during the spring (Cal Boating 2002). A 1997 study showed that Delta received most of its boating use during daylight hours. The Delta received the most use by boaters during the summer months. July was the most popular month, averaging slightly more than four days of use per week. August received the second most use, followed by June. December was the least popular month to boat in the Delta (Delta Protection Commission 1997).

The Old River and Connection Slough sites are in the southeastern corner of an area that Cal Boating defines as the West Zone (one of six recreation zones in the Delta). Over half of the total acres of navigable waters in the Delta are in the West Zone, which encompasses the Old River and portions of the Middle River. This zone contains approximately 152 linear miles of navigable waterways and is considered the water recreation hub of the Delta. Temporary barriers with boat ramps are located at Old River at Tracy and at the Grant Line Canal. About 42 percent of the total visitation in the Delta is in the West Zone, which contains over half of the 95 marinas in the Delta and the greatest number of boats on the water. The West Zone is noted for fishing, sailing, and windsurfing; waterskiing is not as popular as in other zones in the Delta, although it does occur (Cal Boating 2002). The Old River site is close to the southern Delta reaches (South Zone); this zone attracts boaters who seek calmer waters as the Diablo Range tempers the wind. Old River is cited as an existing access point for boating, personal watercraft use, and waterskiing (Cal Boating 2002; Delta Protection Commission 2006). Two marinas are located approximately 0.8 and 1.7 miles south and southwest of the Old River site (Holland Riverside Marina and Linquist Landing/Rock Slough Resort), and 21 additional marinas are located at Bethel Island, on the northwest side of Holland Tract. These marinas are in the West Zone. A number of large vessels also are docked at Discovery Bay, which is within the South Zone.

The California Department of Parks and Recreation (2009) reports that there were approximately 21,270 day users at Franks Tract State Recreation Area in fiscal year 2007-2008. Franks Tract is north of the proposed gates; however, it is assumed that a portion of the Franks Tract recreation use would come from areas south of the gates, including Discovery Bay. Vessel counts along

Threemile Slough and West False River), roughly 7 miles from the Old River site, indicate that vessel traffic is roughly three times greater on weekends than on weekdays (DWR 2009a).

The 1997 Delta Protection Commission survey showed that powerboats were the most common recreation vessel used in the Delta; over 69 percent of respondents owned one or more powerboats. Personal watercraft were the second most common vessel (15 percent), followed by sailboats (6 percent), paddle boats (6 percent), and houseboats (4 percent). The powerboats averaged 19.3 feet in length, and over 50 percent of the powerboats were between 16 feet and 20 feet in length. Houseboats were the longest vessel, averaging slightly over 40 feet. The average sailboat, at 27.2 feet, was the next longest vessel type. Paddle craft and personal watercraft averaged 11.2 feet and 8.1 feet, respectively.

Boats are currently able to travel on the Old River between Bacon and Holland islands and on Connection Slough between Bacon and Mandeville islands throughout the year, although a bridge just west of the Connection Slough site must be opened to allow large vessels to pass. The general area appears to be popular with boaters, and a Contra Costa County Sheriff's Department representative indicated that the Old River area is heavily used by recreational boaters, including water skiers, wakeboarders, and those using personal watercraft. Some yachting also occurs. Connection Slough is less heavily used than Old River (personal communication, D. Powell 2008).

Several temporary barriers are periodically installed in the south Delta as part of the South Delta Temporary Barriers Project. They are usually installed between September 15 and November 30, but also have been in place between April 15 and May 30 during some years. The project consists of four rock barriers across South Delta channels – Old River near Tracy, Middle River, Grant Line Canal, and Head of Old River (HOR). The HOR barrier serves as a fish barrier. In 2008, a court order designed to protect delta smelt prohibited the installation of the spring HOR barrier pending fishery agency actions or further order of the court. The remaining three barriers serve as agricultural barriers and are installed between April 15 and September 30 of each season. A boat portage system is provided when these barriers are in place. The distance from these barriers to the Old River site, which is more commonly used by boaters than the Connection Slough site, is shown in Table 3.12-1.

Table 3.12-1 Distance from Temporary Barriers to the Old River Site

Temporary Barrier	Distance to Old River Site
Head of Old River	18 ½ miles
Grant Line Canal	13 ½ miles
Old River near Tracy	12 ¼ miles
Middle River	8 ¾ miles

3.12.2 Regulatory Setting

The USCG manages maritime mobility as one of its missions and is the lead federal agency on waterways management. USCG creates guidelines (such as for signage or lighting) that are subsequently incorporated by reference by Cal Boating, a state agency whose mission, in part, is providing safe and convenient public access to California waterways. The Project's waterway markers must be consistent with USCG standards (included in California Boating Law, Title 14, Article 6, Waterway Marking System). Each USCG District also prepares weekly Local Notices to Mariners, which are the primary means for disseminating information concerning aids to navigation, hazards to navigation, and other items of marine information of interest to mariners on the waters of the U.S, including the Old River and Connection Slough. Specific types of information include reports of channel conditions, obstructions, hazards to navigation, dangers, restricted areas, and similar items. The Proposed Action must comply with California Harbors and Navigation Code, Section 660, which states that except in emergencies, any measure relating to boats or vessels adopted by any governmental entity other than Cal Boating shall be submitted to the department prior to adoption and at least 30 days prior to the effective date thereof. No local regulations relating to recreational boating are applicable to the Proposed Action.

3.12.3 Environmental Consequences

3.12.3.1 No Action Alternative

The No Action alternative would not result in impacts to recreation because no development would occur.

3.12.3.2 Proposed Action

Boating is the only recreational activity that would be affected by the Proposed Action, which would place temporary, operable gates across Old River and Connection Slough that would affect boaters by:

- Obstructing passage during facilities construction and removal.
- Causing a delay for vessels requiring passage through the barriers while the gates are closed.
- Limiting the maximum vessel size to the clear channel dimensions provided by the gate opening (75 feet at Old River and 60 feet at Connection Slough).
- Increasing the local current velocity through the gate opening due to the constriction of the channel cross-section.
- Adding an obstruction to the river channels.

Obstructing Passage during Facilities Construction and Removal

Most construction/removal would occur within the Old River and Connection Slough river channels. Construction equipment, such as barges and dredges, could obstruct vessel passage, as could the actual placement of the barge-gate structures. As discussed in Section 2, however, during construction, the contractor would be required to maintain vessel access, although some delays could be possible. Notices of construction would be posted at local marinas and in the Local Notice to Mariners to provide advance warning of the construction schedule. Navigational markers would be used to prevent boaters from entering the construction area, and speed limits would be posted. Safe vessel passage procedures would be coordinated with the USCG and Cal

Boating. Impacts during construction would be short-term, lasting only the duration of the in-water construction period (approximately 18 weeks), and minor because access would be permitted at all times.

Potential Delays during Operations

The proposed gates would impede passage when they were closed, requiring those boaters with vessels less than 24 feet/10,000 pounds to use the boat ramps; those with larger vessels or sailboats, or those who choose not to use the ramps, would have to schedule their trips during times when the gates were open or seek alternate routes. Impacts to recreational vessel passage on the Old River channel would be greater than along Connection Slough due to the higher volume of traffic.

The proposed operations scenario is described in Table 2-4. The gates would be in an open position much of time. They would be open throughout April and May and from July through November, during which time vessels could pass and be minimally impeded. From December until March, the gates would be closed for approximately 0.5 hour to 2.5 hours a day. During March, the Old River gates would be closed on flood tide, up to 10 hours a day (flood tide occurs twice a day; therefore, the gates would be closed for two approximately 5-hour periods a day), and the Connection Slough gates would be closed for approximately 20 hours, except during a 4-hour period during slack tides. During June, the Old River gates would be closed about 10 hours per day on flood-tide and open on ebb-tides (including slack-tides) about 14 hours per day, and the Connection Slough gates would be open about 4 hours per day on slack-tides. During March and June, when there is a relatively higher demand for recreation, the Old River gates would be opened approximately every two hours for approximately 15 to 20 minutes to allow transit by boats if present[6]. Thus, boaters would experience of delays of no more than 2 to 2.5 hours if waiting for the Old River gate to open.

The Sector Waterways Management Division (USCG Station Yerba Buena Island) would be kept informed about the Proposed Action, so that relevant information regarding the gates, methods of vessel passage, expected closure schedule, and duration of barrier installation activities was included in the Local Notice to Mariners. The USCG also would update navigation charts as appropriate. Additionally, an outreach program would be implemented to inform boaters of the purpose of the Project, expected duration of gate closures, and operational characteristics of the gates. The program would include notices in local newspapers and boater publications as appropriate; notices also would be posted at local marinas and boat launches and on the project website.

Signage would be provided at the gates showing the times the gates would be opened and closed; signage also would be provided along key channels leading to the gates (Figure 2-2), notifying boaters that the channels may be closed periodically, and providing contact information for the operations schedule. Boaters would be able to communicate directly with the gate operators by phone or marine radio to determine when the gates would be open and alter their routes or time their arrivals at the gates to avoid closures.

[6] Connection Slough receives minimal use by boaters and therefore these periodic openings would not be required at this location.

Based on the 1997 study by the Delta Protection Commission, most boats in the area are expected to be powerboats or personal watercraft or paddle craft that are less than 24 feet and 10,000 pounds and could use the boat ramps. When the gates are closed, boats other than sailboats that are 24 feet or smaller and 10,000 pounds or less would be provided portage through use of the boat ramps, trailers, and tow vehicles provided and operated solely by the gate operator. It is estimated that portage of each boat would take approximately 15 minutes. The gates would be staffed 24 hours per day when operated. Similar systems are already in use elsewhere in the Delta, as discussed in Section 3.12.1 above.

Additionally, an educational program would be implemented to inform boaters of the purpose of the Proposed Action, expected duration of installation activities and gate closures, and operational characteristics of the gates. The program would include notices in local newspapers and boater publications as appropriate; notices also would be posted at local marinas and boat launches. Signage would also be provided at the gates showing times the gates would be opened and closed. Given the implementation of this public education program, the periodic impacts would be considered moderate, but the following measures would be implemented in order to minimize impacts to the extent feasible.

No restrictions to boater access would occur once the gates were removed at the end of the five-year demonstration period.

Limits to Vessel Size

The Old River site has been designed with a 75-foot clear channel, which is sufficiently large to accommodate the large recreational vessels that use the area. Such vessels are currently passing through a 75-foot-wide navigation opening at the Orwood Railroad Bridge, which is just south of the Old River barrier site. The Connection Slough site has a 60-foot opening, which would accommodate the types of vessels that use this portion of the affected river channel (Moffatt & Nichol 2008). The bottom of the Old River gates would be at -19 feet MSL, and the bottom of the Connection Slough gates would be at -13 feet MSL. Tidal elevation in the area varies by plus or minus about 3 feet at these sites. Other shoaling areas in the vicinity are equally shallow; therefore, the gates should not be the controlling factor for depth in these areas. Moreover, it is unlikely that the recreational boats that use this area would have a draft as deep as 10 feet. Therefore, the proposed gates should not limit the size of vessels expected to use these channels.

Increased Local Current Velocity

The gates could be opened within minutes, but there would be sufficient time for the water levels to equalize and to facilitate navigation through the gate (refer to Appendix J). A boat safety exclusion zone would be established to keep boats clear of the closed gates in case the gates began to open, both to avoid gate swing and changes in current velocity. Impacts from increased current velocity would be minor.

Channel Obstruction

Signage would comply with navigation requirements established by the U.S. Aids to Navigation System and the California Waterway Marker system. Channel markers also would be installed to show that the center opening (between the gate pivot posts) is the only navigable opening in the structure, and the side openings are not to be used (between the pivot post and the abutment).

Gate structure markers would be used to indicate the limits of the structure and to indicate when the gate was closed or open to vessel traffic. The marker system would function for both day and night operation, and in times of reduced visibility (fog). Three sets of flood lights also would be included in the design, allowing the eastern and western gates and boat ramp to be illuminated.

A fender system is proposed to provide protection to the gate structure resulting from potential vessel impact. The fenders would consist of six timber pile dolphins constructed at each site. Three fenders would be placed at the sides of the navigation channels on the upstream and on the downstream approaches to the gates approximately 40 feet from the face of the barge. Vessel and recreational boating traffic intending to pass through the gates would enter the channel aligned with the gate opening and would not change direction until it has passed through. Impacts from channel obstruction would be temporary, lasting only until the gates were removed, and minor because the gates would comply with applicable navigation requirements. Additional discussion of safety impacts to boaters, water skiers, wakeboarders, and those using personal watercraft is included in Section 8, Hazards and Hazardous Materials.

The Proposed Action would not directly affect other nearby or outlying recreation facilities. Boaters may choose to launch their boats at other facilities while the gates are closed or during the demonstration period. In addition, boaters might choose to take different routes during periodic gate closures, but this would not result in the deterioration of any recreational facilities or otherwise result in physical effects on the environment; however, the Proposed Action may result in some changes in social and recreation use patterns.

3.13 Socioeconomics

3.13.1 Affected Environment

The proposed facilities would be located in a rural portion of Contra Costa and San Joaquin counties. The Old River and Connection Slough sites do not contain developed retail or commercial structures or occupied housing. Active marinas, including retail shops, boat launching facilities and liveaboard vessels, are located about 0.8 and 1.8 miles from the Old River site. The nearest populated area is in the city of Oakley, about 2.4 miles west of the Old River site. Commercial development in Discovery Bay is located approximately 6 miles from the Old River site and 8 miles from the Connection Slough site.

3.13.2 Regulatory Setting

No federal, state, or local regulations regarding socioeconomics are directly applicable to the Proposed Action.

3.13.3 Environmental Consequences

3.13.3.1 No Action Alternative

The No Action alternative would have no impacts on socioeconomics because no construction would occur.

3.13.3.2 Proposed Action

Construction

Approximately 30 workers would be required to construct the proposed facilities. Construction would occur over an approximately 21-week period. It is likely that fewer workers would be required to remove the facilities and perform site restoration during the four-week de-construction period after the five-year demonstration period. Given the small number of workers involved and the brief construction schedule, these workers would readily be available from the local population, and no influx of workers would be required. The only new permanent workers would be the gate operators, who would be required only from December through March and during June. These workers could be drawn from the local population. No residences would be constructed as part of the Proposed Action, nor would infrastructure be extended into an area where it did not already exist. Power would be drawn from power lines that are already present near the sites.

The Proposed Action would result in minor socioeconomic benefits by providing periodic jobs for construction workers. Construction benefits would be attributed to an expected increase in local spending during the approximately 21-week construction period. Increases in local spending are associated with expenditures by construction workers at local businesses (e.g., restaurants, gas stations, convenience stores, etc.). In addition, the local economy could benefit from project-related outlays on materials and service secured from local providers. There would also be direct benefits to the construction workforce utilized to build the project, including the creation of new jobs and generation of personal income, which could provide local benefits if the local workforce is utilized. Secondary economic benefits could also be realized to the extent that there are existing inter-industry linkages in the local economy, which facilitate the purchase of local goods and services as inputs to production. Due to the short duration of construction activities, any increase in demand for local housing to accommodate construction workers is expected to be minor.

At the business level, there is the potential that project construction could adversely affect marina operators in the vicinity of proposed construction activities at Old River and Connection Slough. During construction, the navigability of affected waterways may be affected periodically to accommodate installation of the gates and ancillary facilities. Further, construction activities may detract from the recreational quality of the area in the short term. In response, local marinas may experience a decline in business if recreational boaters elect to recreate elsewhere in the Delta. These effects, however, would be minimized through efforts to maintain vessel accessibility through the affected stretches of the river, a public outreach and educational program informing potentially affected boat owners and marina operators of construction activities, and that construction is partially scheduled during the months of September, October, and November, which falls outside the peak summer recreation season.

Operations

Similar to construction, it is anticipated that operations would also generate socioeconomic benefits and costs. The benefits expected during operations would come in the form of long-term employment at the two gate facilities, which would be staffed by full-time employees while the gates were being operated. Because the number of anticipated employees required to operate the gates is limited, these benefits would be minor, and no housing-related impacts are anticipated.

Operations of the gate facilities may adversely affect recreational opportunities in the area by limiting navigational access during the periods when gates are closed. As a result, boat owners utilizing marina services near the proposed facilities may elect to move their vessels to other nearby marinas if they feel that recreation opportunities are being limited and/or the quality of their recreational experience is being diminished. In addition, recreation boaters that frequent the Delta waterways may elect to avoid the gate facilities by selecting alternative routes to access their destination. In these cases, there is the potential for lost revenues for nearby marina operators. However, the gates would only be closed between December and March and in June as described in Table 2-4. Further, during March and June, when there is a relatively higher demand for recreation, the Old River gate would be opened approximately every two hours for approximately 15 to 20 minute to allow transit by boats if present[7]. The operations schedule would be posted at marinas and boat launches, in local newspapers and boater publications as appropriate; and on the project website. Boaters also would be able to communicate directly with the gate operators by phone or marine radio. Boaters could therefore schedule their trips to correspond to times when the gates are open. Additionally, when gates were closed, smaller boats (excluding sailboats) would still be able to navigate the river channel by using boat ramps constructed at the gate facilities. These ramps would provide portage around the gates, although the time required to travel through the gates would be slightly longer than with an unobstructed channel. With these measures in place, the potential economic impacts of the Proposed Action would be minimized. Overall, the net economic effect on the regional economy would be negligible.

3.14 Transportation

3.14.1 Affected Environment

3.14.1.1 Ground Transportation

The Old River and Connection Slough sites are accessed by SR 4, which begins in Hercules and passes through Martinez, Concord, Pittsburg, Antioch, and Oakley before intersecting with Interstate 5 in Stockton. Traffic counts at selected intersections in these communities are shown in Table 3.14-1. Local access roads to the Old River and Connection Slough sites are shown on Figure 2-3. The levee on Holland Tract is on the west bank of Old River and is accessible by road by proceeding through the Town of Knightsen and crossing Delta Road Bridge on Delta Road. The east side of Old River is accessible through West Bacon Island Road through an unpaved section of road approximately 10 miles from SR 4. Private roads must be used to access the Old River site. The Bacon Island levee on Connection Slough is accessible by taking Bacon Island Road off SR 4. Mandeville Island can be accessed by a private bridge at Connection Slough.

[7] Connection Slough receives minimal use by boaters and therefore these periodic openings would not be required at this location.

Table 3.14-1 SR 4 Traffic Counts at Selected Intersections				
Description	Back Peak Hour	Back Annual Average Daily Traffic (AADT)	Ahead Peak Hour	Ahead AADT
Hercules, Junction Route 80			3400	38,000
Junction Route 680	8000	89,000	7000	86,000
Concord, Port Chicago Highway West	7100	97,000	11,700	159,000
Pittsburgh, Railroad Avenue Interchange	8800	126,000	7900	114,000
Antioch, Contra Loma Boulevard Interchange	7800	112,000	7200	104,000
Oakley Road	2450	35,000	2150	30,500
Brentwood, South City Limits	1550	16,900	1900	20,600
Discovery Bay Boulevard	1550	19,600	820	9200
Contra Costa/San Joaquin County Line	830	9200		
Contra Costa/San Joaquin County Line			830	9200
Stockton, South Junction Route 5	2850	29,000	2050	17,200
Stockton, North Junction Route 5	2050	17,200	7200	88,000
Source: California Department of Transportation (CalTrans) 2007				

3.14.1.2 Vessel Transportation

The inundated portions of the Connection Slough and Old River sites are navigable from the San Joaquin River. Boats are currently able to travel on the Old River between Bacon and Holland islands and on Connection Slough between Bacon and Mandeville islands throughout the year, although the bridge just west of the Connection Slough site must be opened to allow large vessels to pass. Per U.S.C. Title 33: Navigation and Navigable Waters, Section 117.150, the drawbridge shall open on signal from May 1 through October 31 from 6 a.m. to 10 p.m., and from November 1 through April 30 from 9 a.m. to 5 p.m. At all other times, the draw shall open on signal if at least four hours notice is given to the drawtender during regular operating hours or to the Rio Vista Bridge across the Sacramento River, mile 12.8. The draw shall open on signal if at least one hour notice is given for emergency vessels owned, operated or controlled by the United States or the State of California, for commercial vessels engaged in rescue or emergency salvage operations, or for vessels in distress.

A Contra Costa County Sheriff's Department representative indicated that the Old River area is heavily used by recreational boaters, including water skiers, wakeboarders, and those using personal watercraft. Some yachting also occurs. Connection Slough is not heavily used (personal communication, D. Powell 2008). Additional information regarding recreational boating is included in Section 3.12, Recreation.

The Roberts Island #1 disposal site is located along the Stockton Deepwater Ship Channel, which extends from Suisun Bay into the San Joaquin River and ends at the turning basin in the City of Stockton. The channel is capable of accommodating up to Panamax-size vessels that are fully loaded and sailing at high tide. The waterway has no width restriction, and can handle

45,000 to 55,000 ton class ships fully loaded. Up to 80,000 ton class vessels can transit the channel partially loaded (Port of Stockton 2009).

3.14.2 Regulatory Setting

3.14.2.1 Ground Transportation

No federal regulations are relevant to the ground transportation impacts associated with the Proposed Action. CalTrans has authority over the state highway system, including mainline facilities, interchanges, and arterial state routes. CalTrans approves the planning and design of improvements for all state-controlled facilities. Both CalTrans and local jurisdictions generally assess the impact of long-term, not short-term, traffic conditions. Plans and policies included in the Contra Costa County (2005) and San Joaquin County (1992) General Plans related to transportation seek to plan for and accommodate future growth and the vehicular, transit, pedestrian, and bicycle demand associated with that growth and are not applicable to short-term construction traffic, the primary source of traffic associated with the Proposed Action.

3.14.2.2 Vessel Transportation

The USCG manages maritime mobility as one of its missions and is the lead federal agency on waterways management. USCG creates guidelines (such as for signage or lighting) that are subsequently incorporated by reference by Cal Boating, a state agency whose mission, in part, is providing safe and convenient public access to California waterways. The Project's waterway markers must be consistent with USCG standards (included in California Boating Law, Title 14, Article 6, Waterway Marking System). Each USCG District also prepares weekly Local Notices to Mariners, which are the primary means for disseminating information concerning aids to navigation, hazards to navigation, and other items of marine information of interest to mariners on the waters of the U.S, including the Old River and Connection Slough. Specific types of information include reports of channel conditions, obstructions, hazards to navigation, dangers, restricted areas, and similar items. The Proposed Action must comply with California Harbors and Navigation Code, Section 660, which states that except in emergencies, any measure relating to boats or vessels adopted by any governmental entity other than Cal Boating shall be submitted to the department prior to adoption and at least 30 days prior to the effective date thereof. No local regulations relating to recreational boating are applicable to the Proposed Action.

3.14.3 Environmental Consequences

3.14.3.1 Ground Transportation

Construction

Most materials would be delivered to or removed from the Old River and Connection Slough sites via barge. A maximum of four to eight daily truck trips would be required during the installation of the project facilities, and approximately 60 daily trips would be associated with the up to 30 construction workers. Removal would generate fewer trips than construction because it would last for only four weeks, as opposed to approximately 21 weeks, and less materials handling would be required. SR 4 is a heavily traveled road, and the minor, temporary addition of construction traffic would not cause a perceptible increase in traffic or affect the capacity of the street system. Very little traffic is expected on local roads that allow access to the

Old River and Connection Slough sites due to their remote location, and temporary impacts to local roads would be minor.

The Proposed Action would be located in a remote area and would not involve any design features that would affect roadways. Farm equipment could be present in the vicinity of each of the sites, but construction activities would be confined to limited areas and would not conflict with the equipment use. Any impacts to levee roads, associated maintenance roads and access roads that result from land-based construction equipment use would be temporary because they would be restored to pre-construction conditions once construction was completed. For example, it may be necessary to grade and apply gravel to the Holland Tract access road. It also may be necessary to grade and gravel the access road across Bacon Island to the dredge disposal site and to pave small sections on the Bacon Island Road between SR 4 and Connection Slough to ensure safe passage of land-based construction equipment.

Passage along the levee roads in the immediate vicinity of the Old River and Connection Slough sites would be restricted during the construction/removal periods, but this area is remote, and the likelihood of emergency access being required is low. On Bacon Island, it is possible that one traffic lane could be kept open, but the roads are narrow on Holland Tract and Mandeville Island, and this may not be feasible at those locations. Impacts would be lessened during facilities removal because some of the sheet pile and rock would be left in place and less material would be located within the construction laydown area. The construction contractor would coordinate with the Contra Costa and San Joaquin County Sheriff's and Fire Departments to notify them of the construction/removal schedule and identify alternative access methods if needed in order to ensure that emergency access is available.

Operations

During operations, trips would be limited to those associated with any monitoring, inspection or maintenance that was required, and trips generated by the operators arriving at and departing the control house at each of the sites. The minor number of trips periodically generated by the Proposed Action would not cause a perceptible increase in traffic or affect the capacity of the street system.

3.14.3.2 Vessel Transportation

Construction

The Proposed Action would comply with navigation requirements established by the U.S. Aids to Navigation System and the California Waterway Marker system, and therefore would not substantially increase hazards to navigation. Barges would be used to transport equipment and materials to and from the Project sites, but they are commonly used on Delta waterways and this brief period of increased barge activity would not substantially increase hazards to navigation. If the volume of dredged material exceeded the storage capacity of the Bacon Island site, it would be placed in barges and towed to Roberts Island. Barges likely would travel north on Old River to the San Joaquin River and then to the disposal site, which is located along the Stockton Deepwater Ship Channel. From Connection Slough, they likely would travel north on Middle River to the San Joaquin River and then follow the ship channel to the disposal site. Three barges would be used to expedite the process – one loading, one unloading, and one in transit. Assuming a barge capacity of 2,000 cubic yards per trip and an estimated 10,000 to 40,000 cubic

yard of sediment that would be transported, between 5 and 20 roundtrips would be required. The barges would comply with all navigational requirements, and this minor increase in barge activity would not result increased congestion, hazards, or other factors affecting Delta waterways.

Operations

The gates would restrict access to Old River and Connection Slough while they were closed, but they could be opened in about three minutes. They would be staffed by an operator 24 hours per day when the gates are operating to accommodate any potential emergency, and would be opened or closed at the request of appropriate authorities, including Contra Costa and San Joaquin County Sheriffs' Departments or the USCG. Thus, they would not impede commercial and emergency access.

The vessel passage is being designed with a 75 foot clear channel in Old River and a 60 foot channel at Connection Slough. The bottom of the Old River gates would be at -19 feet MSL, and the bottom of the Connection Slough gates would be at -13 feet MSL. Discussions with commercial operators have confirmed that such an opening is adequate to accommodate commercial vessels (Moffatt & Nichol 2008). Impacts to recreational boaters are addressed in detail in Section 3.12, Recreation. As discussed, the gates may cause a temporary delay while they were closed, but they would be opened upon request to accommodate commercial and emergency vessels.

3.15 Climate Change

3.15.1 Affected Environment

Climate change refers to long-term fluctuations in temperature, precipitation, wind, and other elements of Earth's climate system. Natural processes such as solar-irradiance variations, variations in Earth's orbital parameters, and volcanic activity can produce variations in climate. The climate system can also be influenced by changes in the concentration of various gases in the atmosphere, which affect Earth's absorption of radiation. California law defines these Greenhouse Gases (GHG) to include the following: CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (Health and Safety Code, Section 38505(g)). The most common GHG that results from human activity is CO_2, followed by CH_4, and N_2O (OPR 2008).

The BAAQMD has prepared a GHG emissions inventory using 2002 as the base year. The BAAQMD estimated that 85.4 million tons (77.5 million metric tonnes) of CO_2-equivalent GHGs were emitted from anthropogenic sources in the Bay Area in 2002. Fossil-fuel consumption in the transportation sector (on-road motor vehicles) accounted for approximately 43 percent (BAAQMD 2006). Comparable information is not available for the San Joaquin Air Basin.

3.15.2 Regulatory Setting

There currently is no federal, state, or local regulatory guidance for determining whether a project advances or hinders GHG reduction goals, and no standards of significance for GHG impacts have been established pursuant to NEPA.

3.15.3 Environmental Consequences

3.15.3.1 No Action Alternative

The No Action alternative would not affect climate change because no development would occur.

3.15.3.2 Proposed Action

This analysis addresses the generation of GHG emissions and the potential for the Proposed Action to conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing GHG emissions.

During facilities construction and removal, the Proposed Action would temporarily cause direct GHG emissions from the combustion of fossil fuels (i.e., diesel, gasoline) used to run construction equipment and vehicles, both onsite and offsite. Over its lifetime, the Proposed Action would directly and indirectly cause negligible GHG emissions from occasional maintenance and personal vehicle use, the periodic use of diesel-powered generators, and/or the use of electric power used to run hydraulic pumps on an intermittent basis. Therefore, this analysis focuses on construction impacts (impacts from removal activities would be far less because less time and equipment use would be required and are not calculated).

Table 3.15-1 shows estimated GHG gas emissions for the Proposed Action based on the EPA's published emission factors and CARB's EMFAC model for diesel and gasoline fuel internal combustion.

Table 3.15-1 Estimated Total GHG Emissions During Construction

Project Emissions	tons	tonnes
Carbon Dioxide (GHG - CO_2)	1,197	1,086
Nitrous Oxide (GHG - N_2O)	0.030	0.027
Methane (GHG - CH_4)	0.067	0.061
Carbon Dioxide Equivalents (CO_2eq)	1,208	1,096

Sources: EPA 2006, CARB 2006a, EPA 2009

Notes:

tons – short tons (2,000 pounds)

tonnes – metric tons (1,000 kilograms or 2,204.6 pounds)

As shown in Table 3.15-1, the entire Proposed Action would emit approximately 1,208 tons of CO_2–equivalent GHG. This amount is very small (0.0014 percent) in comparison to the 85.4 million tons of CO_2 equivalents emitted per year in the Bay Area alone. The generation of direct onsite and offsite GHG emissions would be intermittent and would terminate following completion of installation and removal activities. Additionally, in order to minimize emissions to the extent feasible, construction contractors would be required to implement the following measures:

- On-road and off-road vehicle tire pressures would be maintained to manufacturer specifications. Tires shall be checked and reinflated at regular intervals
- Construction equipment engines would be maintained to manufacturer's specifications
- Any onsite vegetation would be preserved or replaced (if removal is necessary for proposed activities) as a means of providing carbon sequestration

Due to the very small quantities involved and the temporary nature of the construction and removal activities, the Proposed Action would not conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing GHG emissions, and impacts would be considered minor.