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SECTION 2

Project Description

2.1 INTRODUCTION

This section provides a detailed description of the 2-Gates Fish Protection Demonstration Project, including the project objectives, purpose and need, location, structural components, construction techniques, project operations, environmental monitoring, coordination with the decision-making process under the OCAP BOs, facilities removal, site restoration, and protective measures. Additional and supporting details are provided in several appendices such as: Appendix A. Particle Tracking and Analysis of Adult and Larval/Juvenile Delta Smelt; Appendix B. Operations Plan; Appendix C. Science and Monitoring Plan; Appendix D. 95%Design Plans for Old River Site and Connection Slough Sites; Appendix E Hydrodynamic Analyses of 2-Gatres Flood Stage Issues; Appendix F. Hydrodynamic Analysis of 2-Gates Near Field Effects; Appendix G. Consultation Letters; Appendix H, Dry and Wet Season Sampling for Federally Listed Large Branchiopods, and Appendix I, Habitat Assessment for the Giant Garter Snake.

2.1.1 Project Overview

The 2-Gates Project is intended to provide temporary, cost-effective, immediate protection to delta smelt from entrainment in SWP and CVP export facilities by controlling the combined OMR flows. The Project proposes to close the gates a few hours a day to effect the dispersal of turbidity into the South Delta Channel near the export facilities to protect adult prespawning delta smelt and then operate the gates on a open on ebb tide, closed on flood tide mode to create dispersive mixing to move larval/juvenile smelt and reduce entrainment risk. The gates operate with the OMR flow restrictions. This will be accomplished by the installation of temporary “butterfly gates” in Old River and Connection Slough and operation of those gates when turbidity and salinity conditions will support upstream movement of delta smelt or larval dispersal (Appendix B. Operations Plan).

Project-related changes to the movement of water and the timing of water movement were evaluated using a set of hydrodynamic models that function in a manner similar to the “Delta Simulation Model II” (DSM2),[1] its associated modules, and post-processing applications. Overall, the results from the DSM2-related models indicate that under certain hydrologic conditions (including all normally expected OMR flows) when delta smelt are located north and west of the 2-Gates Project facilities, the gates will be effective at reducing entrainment of delta smelt, other weak-swimming fish, and plankton from the western and central Delta by the SWP and CVP export facilities in the southern Delta. Model results are presented in Appendix A. Preliminary results from the newly developed adult delta smelt behavioral model applications further indicate that the distribution and density of adult delta smelt can be modified to reduce their potential entrainment at the CVP and SWP export facilities while they are operating within the OMR flow restrictions identified in the OCAP BOs (USFWS 2008, NMFS 2009).

[1] DSM2 models calculate stages, flows, velocities in channel segments in the Delta and is the basis for many post processed models that calculate water quality parameters and the movement of individual particles. Detailed descriptions of this model are available at http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dsm2/dsm2.cfm.

Entrainment reduction may be accomplished by controlling the distribution and continuity of turbidity and salinity conditions that have been identified in the FWS OCAP BO (2008) as a component of pre-spawning, adult delta smelt habitat.

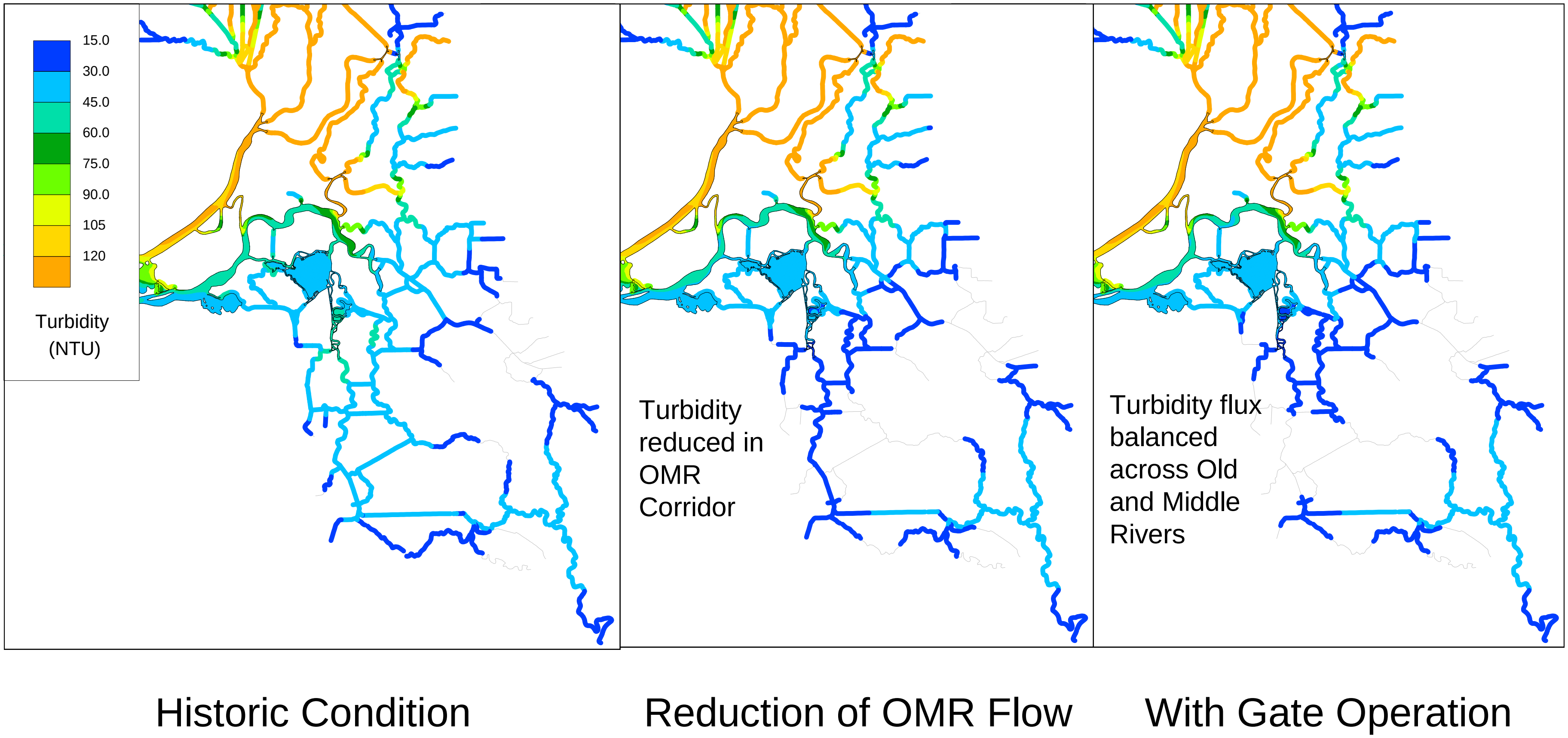
Preliminary results from the adult delta smelt behavioral model applications (Appendix A) suggest that operation of the 2-Gates Project (Figure 2-1), in concert with OMR flow restrictions (USFWS 2008), and could modify the distribution and density of adults to reduce the potential for entrainment at the CVP and SWP export facilities. The distribution of larval and juvenile delta smelt depends on spawning locality (distribution of spawning adults) and Delta hydrodynamics (USFWS 1994). Restricting the presence of pre-spawning adult delta smelt from some portions of the south Delta may reduce potential entrainment of their progeny (larval and juvenile life stages). The reduction of available habitat for migration and spawning of delta smelt is an important factor to describe and the effects need to be evaluated in this document.

Tidal operation of the 2-Gates Project also may increase dispersive mixing of water in the central or southern Delta seaward toward the western Delta. This has the potential to (1) disperse larval/juvenile smelt spawned in the central and southern Delta away from the export pumps, thereby reducing entrainment risk, (2) transport juvenile smelt westward toward rearing habitat near Suisun Bay, and (3) enhance export of nutrients and phytoplankton to the west Delta. These actions will benefit the species by reducing entrainment of pre-spawning adults. The project benefits may provide operators the flexibility to increase exports while still operating within the required OMR flow range specified in the OCAP BOs (USFWS 2008b, NMFS 2009).

The Project is designed to have the operational flexibility to test alternative water management and fish protection strategies. It includes a monitoring component that is intended to verify that operable gates can control water quality factors, such as turbidity and salinity. Monitoring data will be used to guide real-time operation of the gates, verify the model predictions, evaluate Project effects on delta smelt, and other affected aquatic species, and modify operational procedures as needed (the complete Science & Monitoring Plan is included in Appendix C). Real-time adjustment to operations will be made as needed to reduce delta smelt entrainment while minimizing or avoiding impacts on other listed species. Monitoring will also be used to adjust operations based on changing conditions in the Delta, including changes associated with CVP and SWP operations.

2.1.2 Purpose of the Project

The 2-Gates Project proposes to add a new hydrodynamic and water quality control management tool to those currently available to water and resource management agencies to reduce entrainment of delta smelt by the SWP and CVP export facilities. Based on detailed simulation modeling, this hydrodynamic and water quality control tool can assist water and resource management agencies to achieve or exceed the protection goals established by the OCAP BO for delta smelt (USFWS 2008) while allowing OMR flows to exceed the minimum levels allowed by the RPAs described in the USFWS and NMFS OCAP BOs (by some undefined amount) while complying with other water management requirements of D-1485 and D-1641. In particular, the Project is intended to demonstrate that operable gates, strategically placed in the central Delta and managed in conjunction with some restrictions on reverse (negative) flows in Old and Middle Rivers (OMR flows), can provide equal or greater entrainment protection for delta smelt than restrictions on reverse OMR flows alone. The proposed 2-Gates Project is designed as a demonstration project to test this premise.



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2 **Figure 2-1** **Operation of 2-Gates Project to Reduce Larval / Juvenile Delta Smelt Entrainment**

The 2-Gates Project could be used to support future decision-making regarding the installation of more permanent operable gates for the protection of aquatic resources in the Delta. Should such a permanent project be implemented in the future, it will be subject to separate environmental review and permitting processes, which will evaluate pertinent information collected from operation of the 2-Gates Project. The 2-Gates Project has independent utility, however, and is not dependent upon the implementation of any longer-term plan, including the Bay-Delta Conservation Plan (BDCP). It will not result in a long-term commitment to permitting or constructing permanent gate structures in Old River and Connection Slough. The 2-Gates Project includes removal by the applicant of the gate facilities after 5 years at the end of the demonstration period.

2.1.3 Need for the Project

The CVP and SWP are operated under the OCAP and other water rights and water quality requirements and must comply with the RPAs contained in the recent BOs for the OCAP issued by the USFWS (2008) and NMFS (2009). The USFWS RPAs include actions to limit negative OMR flows to reduce entrainment of delta smelt at the CVP and SWP export facilities. In addition, the CVP and SWP must operate within the water resource management controls described in D-1485 and D-1641. Depending on the level of pumping allowed, water supply impacts can be severe. Therefore, the water agencies that rely on the CVP and SWP are proposing ways to reduce entrainment losses of delta smelt at the export facilities while reliably meeting water supply needs.

2.1.4 Project Objectives

The 2-Gates Project objectives are:

- Provide immediate and cost-effective protection to delta smelt equaling or exceeding that provided by implementation of the USFWS (2008) OCAP BO alone.
- Avoid adverse effects on listed species and other aquatic resources in the Delta, including Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley spring-run Chinook salmon (*O. tshawytscha*), Central Valley steelhead (*O. mykiss*), North American green sturgeon (*Acipenser medirostris*), and longfin smelt (*Spirinchus thaleichthys*).
- Allow SWP and CVP water exports to increase while operating within the required OMR flow range established by the USFWS (2008) and NMFS (2009) OCAP BOs and all other water management requirements.
- Improve understanding of the processes that influence movement and entrainment of delta smelt in the SWP and CVP export facilities in order to minimize entrainment in the future.

2.1.5 Project Location

The Old River and Connection Slough sites are located in the central Delta, approximately 13 and 16 miles northwest of Stockton, and 4.8 and 6.8 miles north and northwest of Discovery Bay, respectively. The nearest developed areas are located in the City of Oakley, about 2.4 miles west of the Old River site. The regional location is shown in Figure 2-2, and a more detailed view of the area surrounding the Project sites is shown in Figure 2-3. The Contra Costa County-San Joaquin County boundary is formed by the Old River; therefore, Project construction at this site will occur in both counties. The Connection Slough site is located entirely in San Joaquin County.

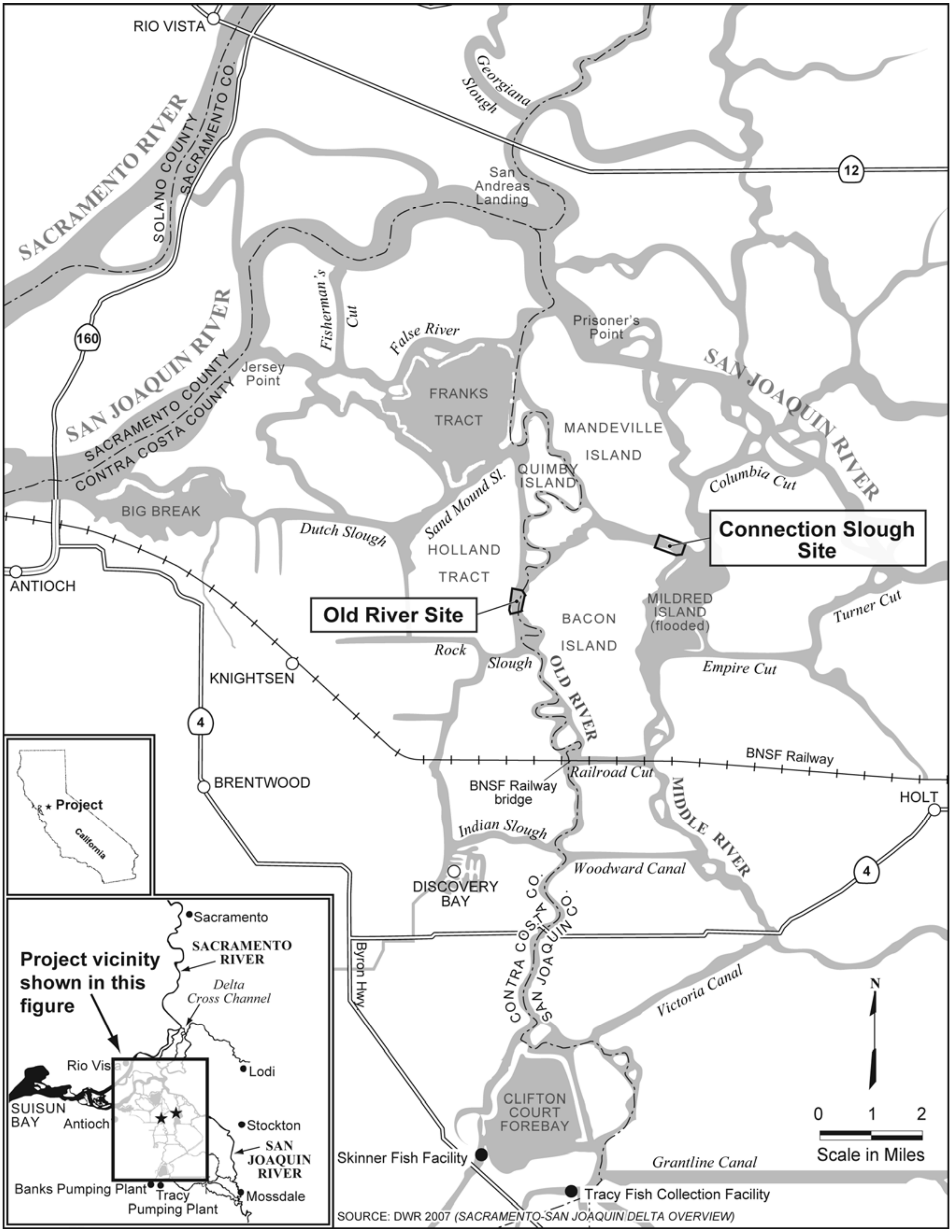


Figure 2-2 2-Gates Project, Regional Location

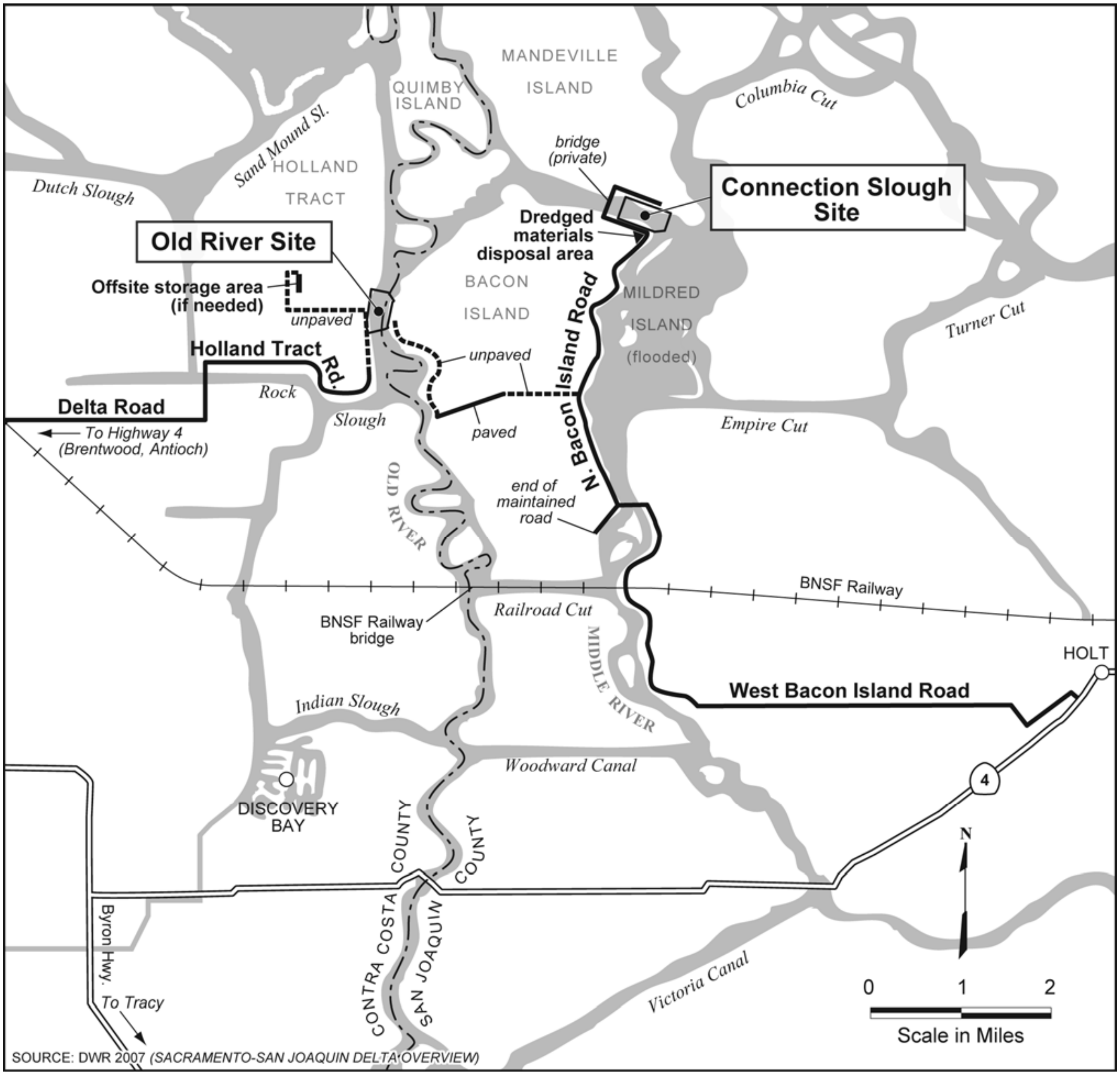


Figure 2-3 **2-Gates Project Local Area and Construction Access**

2.1.6 Action Area

The Action Area is the area to be affected directly or indirectly by the Federal action and is not merely the immediate area involved in the action [50 CFR §402.02]. While the sites for the gates are identified as the area directly affected by the gates, operation of the gates will affect a much larger area in the Delta channels.

This larger area is defined as the area between Old River and Connection Slough sites, which are located in the central Delta, approximately 13 and 16 miles northwest of Stockton, and 4.8 and 6.8 miles north and northwest of Discovery Bay, respectively. The nearest developed areas are located in the City of Oakley, about 2.4 miles west of the Old River site. The regional location is shown in Figure 2-2, and a more detailed view of the area surrounding the Project sites is shown in Figure 2-3. The Contra Costa County-San Joaquin County boundary is formed by the Old River; therefore, Project construction at this site will occur in both counties. The Connection Slough site is located entirely in San Joaquin County. As shown on Figure 2-2, the Old River site is located on Old River between Holland Tract and Bacon Island, about 3 miles south of Franks Tract and about 1 mile north of the confluence of Old River and Rock Slough. The Connection Slough site is located about 3.5 miles southeast of Franks Tract between Mandeville Island and Bacon Island and between Middle River and Little Mandeville Island. Total acreage of the direct action is 9.6 acres of terrestrial habitat and 2.1 acres of aquatic habitat.

The Action Area for the 2-Gates Project is described differently for aquatic species and terrestrial species because of the different nature of the impacts to the Delta channels compared to the physical sites supporting the gate structure and construction activities (Figure 2-4). For aquatic species the Action Area includes the in-channel sites where construction will 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 (turbidity, salinity, temperature) as a result of gate installation and operation. The Action Area of the Delta for the 2-Gates Project includes the Sacramento River from Three Mile Slough to the Delta Cross Channel, the Mokelumne River channels from the confluence with the Cosumnes River to the San Joaquin River, Little Potato Slough, Georgiana Slough, the San Joaquin River channel between Dutch Slough and Mossdale and all interconnected riverine or tidal channels between these identified channels and the south Delta State and Federal fish collection facilities, including the major channels of Old and Middle River, Columbia Cut, Turner Cut, Railroad Cut, Woodward Canal, Victoria Canal and the Grantline Canal (Figure 2-4). The Action Area is entirely contained 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 Action Area includes that portion of the Sacramento River between Three Mile Slough and the Delta Cross Channel that is designated critical habitat for Sacramento Valley winter-run and Central Valley spring run Chinook salmon (see Figure 2-4).

2.1.7 Conceptual Foundation

Project design and operations are based on a conceptual understanding of patterns and relationships of Delta hydrodynamics, changes to the distribution and levels of turbidity and salinity, delta smelt life cycle, delta smelt behavioral responses to flow and water quality cues at different life stages, and salvage at the export facilities, as reviewed below.

Historical entrainment of delta smelt at the export facilities has primarily occurred during the period of December through June. Entrainment risk depends on geographic distribution, with the greatest risk occurring near the south Delta and water export facilities (Kimmerer 2008). The distribution of adult delta smelt is affected by a variety of factors including season, hydrodynamics, and turbidity and salinity. Recent evidence suggests low water transparency is a key characteristic of delta smelt habitat (Bennett 2005, Feyrer et al. 2007, and Nobriga 2008). Water transparency is an important predictor of occurrence for delta smelt. This relationship has been observed for adults (Spring Kodiak Trawl data, Bennett 2009) and juveniles (20 mm survey, Bennett 2009; Fall Midwater Trawl, Feyrer et al.2007). Figure 2-5 is a compilation of years of capture data of delta smelt and water clarity. Data is presented similar to an exceedance plot for river flows and shows the low probability of encountering smelt in low turbidity conditions with increasing likelihood of capture as water turbidity increases. The recently released OCAP BO (USFWS 2008) highlights the relationship between turbidity and delta smelt occurrence and particularly salinity (expressed as electrical conductivity or EC) of less than 1000 µmhos/cm and turbidity greater than 12 nephelometric turbidity units (NTU).

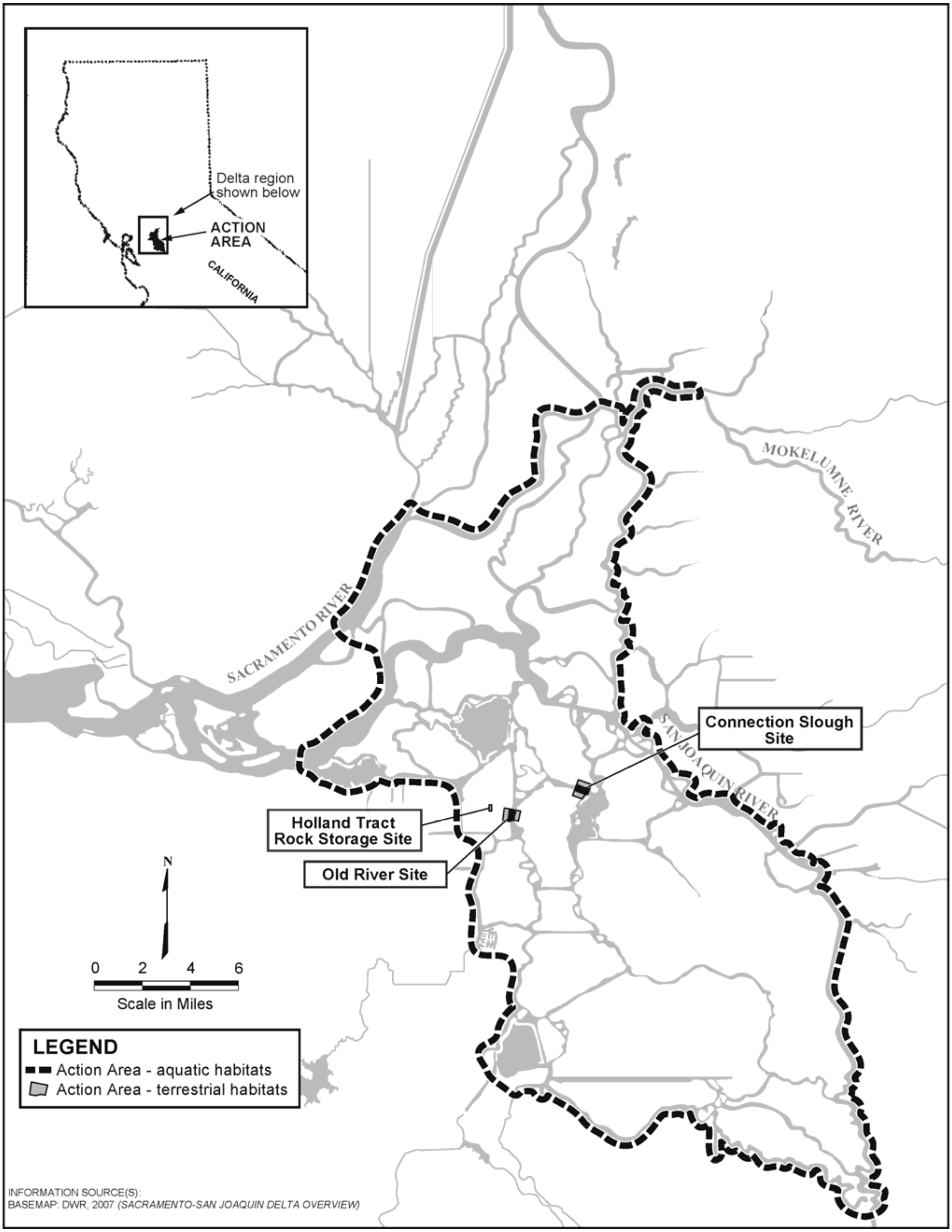


Figure 2-4 Aquatic and Terrestrial Action Areas for Biological Assessment

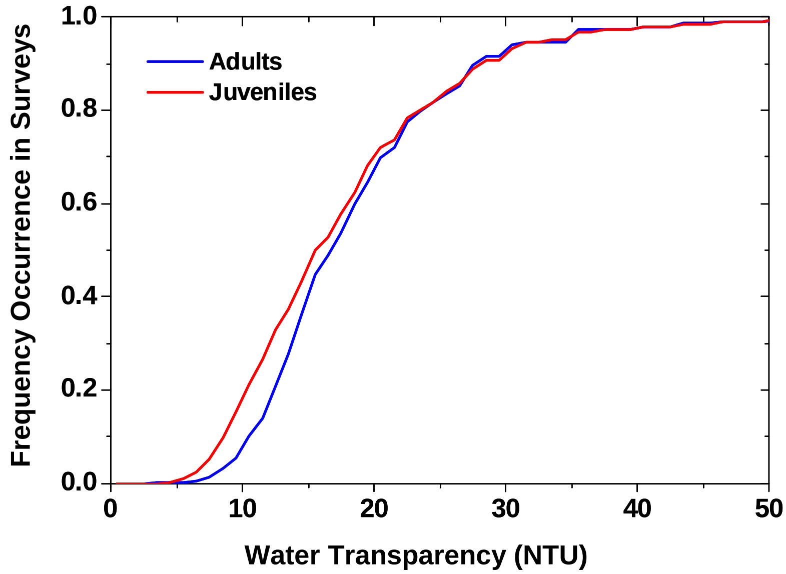


Figure 2-5 Relationship Between Occurrence of Delta Smelt and Turbidity

NOTE: The water transparency values (i.e. turbidity) were derived from Secchi depth readings from Inter-Agency Ecological Program (IEP) data collected at Chipps Island (1986-1999) and converted to turbidity by a nonlinear regression equation (unpublished data from Bennett 2009).

Upstream migration in the winter appears to be triggered by abrupt changes in flow and turbidity associated with the first flush of winter precipitation (Grimaldo et al. 2004). Turbidity in excess of 12-15 NTU is correlated with and may be a functional cue for the annual spawning migration by delta smelt from Suisun Bay to the Delta. Delta smelt seeking these conditions move into the central Delta by surfing the tides and can remain in these areas of suitable water quality as they are influenced by the tides. Under certain hydrologic and operating conditions, these turbid water quality conditions can be drawn into the central and south Delta by tidal pumping in the San Joaquin River and reversal of flows in the channels of Old and Middle rivers. Review of fish salvage trends found a correlation in several years between elevated turbidity in the south Delta, high exports, and increased salvage (USFWS 2008). When exports are high, OMR flows can be reversed and flow south toward the export facilities (i.e., reverse OMR flows). Daily salvage of delta smelt at the export facilities is correlated with reverse OMR flows (Kimmerer 2008). Project operations will redistribute a portion of delta smelt habitat and reduce turbidity levels in a portion of the channels leading toward the export facilities, as shown in Figure 2-1.

The distribution of adult delta smelt presumably affects the location of spawning and the spatial distribution of their progeny. This will affect the entrainment risk of juveniles in the Delta until they move downstream to rearing habitat near Suisun Bay.

The location and structure of the turbidity field is affected by freshwater inflow, tidal flows, and other Delta hydrodynamics, as revealed by recent hydrodynamic modeling of turbidity and flow conditions with and without 2-Gate operations (Appendix A). During winter runoff events, turbidity enters the Delta from the Sacramento River and Georgiana Slough or the Delta Cross Channel gates. Sacramento River flows deliver the turbidity plume to the western Delta. If flows are substantial on the San Joaquin, a third source of turbidity can enter the Delta from the south. During high flow events on the Sacramento River turbidity enters the western Delta, and then is pushed up the San Joaquin River through tidal pumping where it can be drafted toward the south Delta through Old River and Middle River from tidal action and water export operations. Turbidity can also move into the central Delta down Georgiana Slough and then is drafted down Middle River. When these turbidity sources (or the source from the San Joaquin) meet, they form a turbidity "bridge" from the central and west Delta into the south Delta channels (Figures 2-1 [Operation to reduce turbidity] and 2-6 [Historic Condition]). This continuous high turbidity zone facilitates smelt movement south toward the pumping facilities where they are at high risk of entrainment. Water management actions (operation of the SWP and CVP export pumps) as it relates to reverse net flows in Old and Middle rivers consistent with the OCAP RPA actions are designed to reduce the negative flow rates in the south Delta channels and allow delta smelt to use these channels while reducing entrainment. Modeling suggests that OCAP actions to reduce OMR flows also dramatically reduce turbidity in these channels, however, do not appear to reduce turbidity to below levels outside the range used by delta smelt. Thus by reducing negative flows, smelt dispersion into the south channels of Old and Middle rivers would also be reduced otherwise there would be no change the effects of entrainment at the export pumping facilitates.

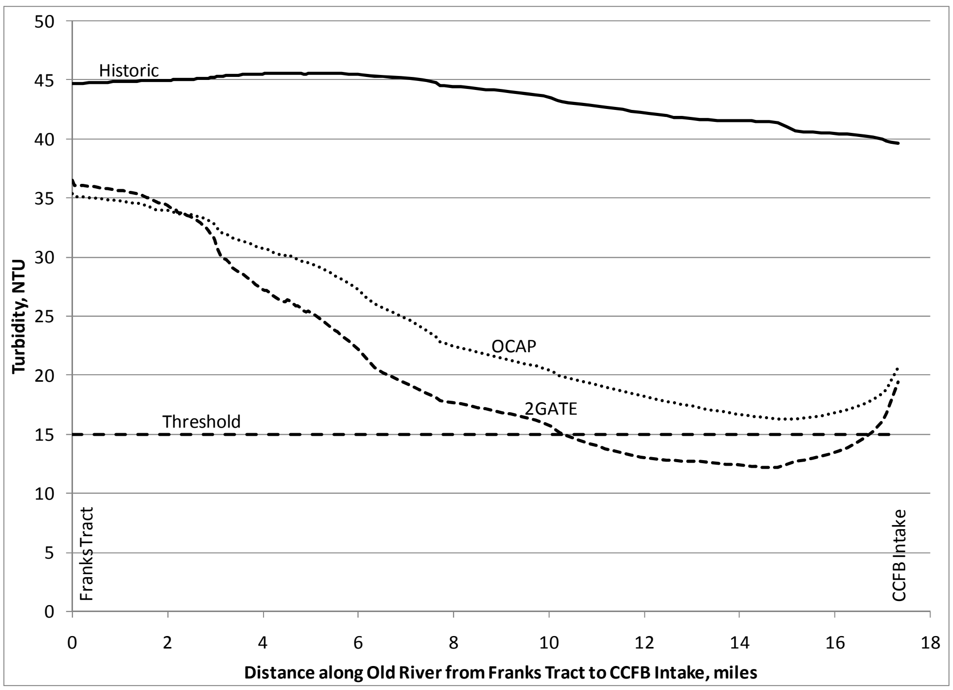


Figure 2-6 Longitudinal Profile of Modeled Turbidity Along Old River from Franks Tract to Clifton Court Forebay Showing the Reduced Turbidity from OCAP Compared to Historic Conditions and 2-Gates Compared to OCAP

The proposed gates, which will be operated within the bounds of the OMR flow requirements of the OCAP BO RPAs, may provide greater control and more flexibility in keeping turbidity away from the pumps. Under existing conditions, Old River is a larger channel and is faster path than Middle River for turbidity entering from the western Delta, while Middle River is a faster path for turbidity entering through Georgiana Slough or the Mokelumne River in the north Delta. Hydrodynamic modeling of different gate operation scenarios (Appendix A) found that closing the gates in Old River and Connection Slough for short periods of 0.5 to 2.5 hour on portions of each flood/ebb tidal cycle, that flows in Old and Middle river channels could be manipulated to achieve the longest travel time of water from the west or north Delta to reach the export locations. By extending the travel time, turbidity decreases with settling, reducing the chance of a turbidity bridge forming and connecting the south and central Delta. The two gates would thus be operated to “balance” flows and modify turbidity levels along the Old and Middle River channels (Figure 2-1), while not changing net flow in these channels.

Entrainment reduction will be accomplished by controlling the distribution and continuity of turbidity and salinity conditions that have been identified as a component of pre-spawning, adult delta smelt habitat. Increased salvage of adult delta smelt is correlated with high turbidity and negative OMR flows (Grimaldo, Miller, Peregrin and Hymanson. 2004). Preliminary results from the newly developed adult delta smelt behavioral model applications (Appendix A) suggest that the distribution and density of adult delta smelt could be slightly modified to reduce their potential entrainment at the CVP and SWP facilities, in concert with the OMR flow restrictions from the USFWS (2008b) OCAP BO and by operating the 2-Gates Project. The redistribution of a portion of pre-spawning adult delta smelt habitat to exclude a portion of Old River and Middle River in the south Delta could also reduce potential entrainment of their progeny (larval and juvenile life stages).

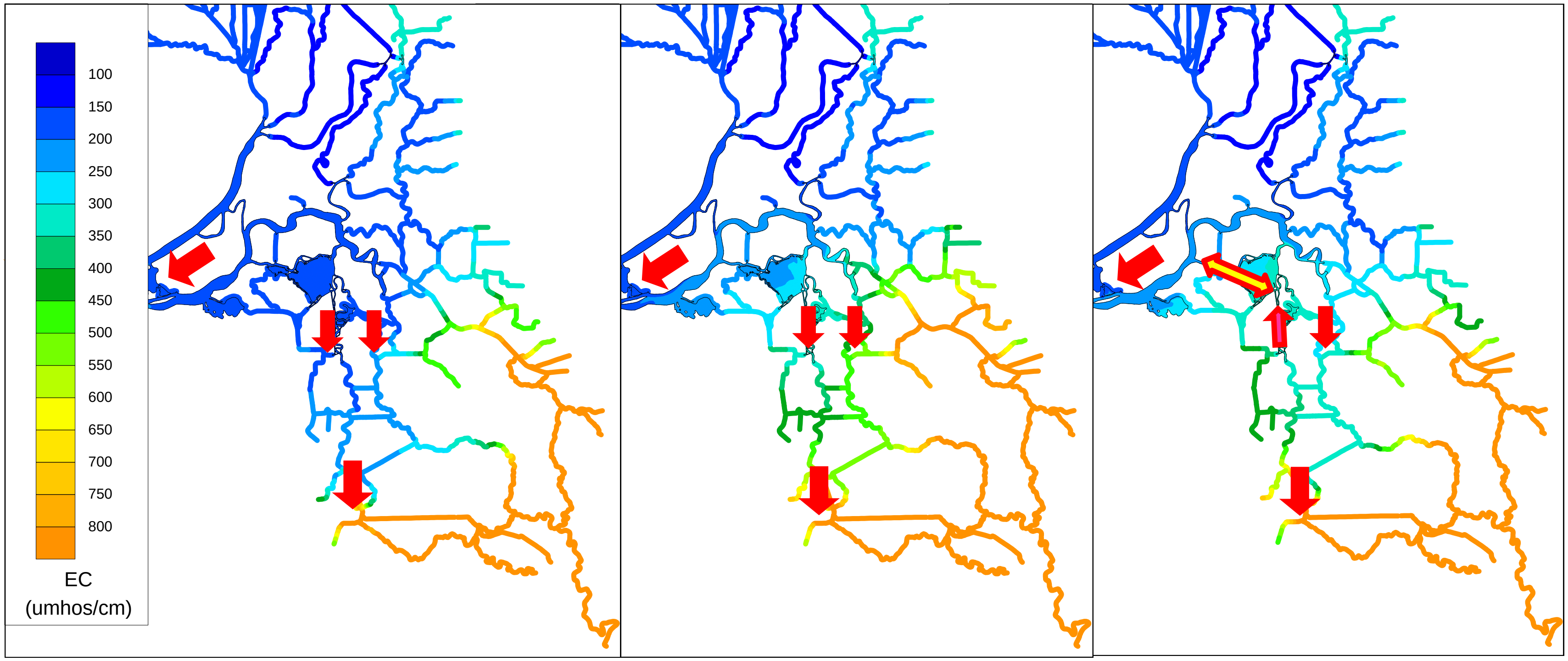
Once adult spawning has peaked, the gates will be operated to transport larval and juvenile delta smelt away from the export facilities. Larval delta smelt presumably drift with the predominant tidal currents, perhaps exercising some control through vertical migrations in the water column (Bennett 2005). They move downstream until they reach favorable rearing habitat, typically in the Suisun Bay region. Hydrodynamic modeling suggests that opening the gates on ebb tides can mix water in the central Delta and disperse flows seaward toward the western Delta (Figure 2-7 and Appendix A). This has the potential to benefit delta smelt by (1) dispersing larvae and juveniles away from the export pumps, thereby reducing entrainment risk, and (2) enhancing juvenile transport and theoretically at least, chlorophyll-A westward toward rearing habitat in Suisun Bay. Particle tracking modeling of this “dispersive mixing” concept using different water management scenarios suggests that entrainment of juveniles could be potentially reduced (Figure 2-7). Finally, this dispersive mixing process could also be used to improve habitat in the Sacramento-San Joaquin confluence area by facilitating westward transport of nutrients and plankton originating in the upper San Joaquin River and southern Delta. The Pelagic Organism Decline (POD) studies hypothesized that “bottom up” factors, such as the quality and availability of food, may have important consequences for pelagic fishes including delta smelt. Low and declining primary productivity in the estuary is likely a principal cause for the long-term pattern of relatively low and declining biomass of pelagic fishes (Baxter, Breuer, Brown, Chotkowski, Feyrer, Gingras, Herbold, Mueller-Solger, Nobriga, Sommer and Souza. 2008). Dispersive mixing will cycle nutrients into the western Delta that otherwise will have been exported.

2.1.8 Questions Addressed by the Project

The Project is designed as a five-year demonstration project to evaluate the effectiveness of operable gate structures in managing Old and Middle River flows, turbidity and entrainment; and to test hypotheses of relationships among flows, turbidity levels and delta smelt distribution. The key questions that will be addressed by the Project are:

- Can the Project reduce pre-spawning adult delta smelt entrainment in the CVP and SWP export facilities by maintaining a zone of low turbidity between the export facilities and the central and western Delta?
- Can the Project reduce juvenile delta smelt entrainment in the facilities by enhancing dispersive mixing to transport them from the south and central Delta into the western Delta?

Several generally-stated hypotheses have been developed regarding physical outcomes of gate operations and biological response of delta smelt (Table 2-1). These hypotheses are designed to test specific questions and underlying assumptions, refine understanding of processes that influence entrainment of delta smelt, and evaluate Project performance. This knowledge will be used to refine the Project design and operation to protect delta smelt and to guide regulatory decision-making. Flow and turbidity hypotheses examine the principle mechanisms influencing adult delta smelt movement. The ability to influence delta smelt distribution is expected to influence the regions of spawning and distribution of larva and juvenile delta smelt.



Historic Condition

Reduction of OMR Flow

With “Open on Ebb” Gate Operation

Figure 2-7 Operation of 2-Gates Project to Reduce Larval / Juvenile Delta Smelt Entrainment

Table 2-1 Hypotheses/Questions

No.	Hypotheses and Questions	Metrics	Data sources
Balanced Flows and Turbidity			
1	2-Gates Project operations can control net flows in Old River to achieve a predictable balance of flows in both Old and Middle Rivers.	Flows in Old and Middle Rivers.	• Existing and new flow monitoring stations. • RMA modeled flows [1].
2	2-Gates Project operations, can balance net flows between Old and Middle rivers, as indicated in 1, to maintain a low turbidity region in Old and Middle Rivers.	• Flows in Old and Middle Rivers • Turbidity (observed) down Old and Middle Rivers and into Franks Tract and lower San Joaquin River. • Model results for flows and turbidity from forecasting and from concurrent conditions.	• Existing and new flow monitoring stations. • Existing and new water quality stations (turbidity, EC, temperature and chlorophyll a). • RMA modeled flows and turbidities [2].
Adult Delta Smelt Migration and Salvage			
3	Migration of pre-spawning adult delta smelt from the Suisun Bay into the Delta and freshwater habitats occurs when initial winter storm events increase Sacramento River turbidity in the Delta to above a threshold of 12-15 NTU.	• Storm event (1st of season) • Delta inflow • Sacramento River flows • Turbidity • Delta smelt catch at fixed stations, one each in the Sacramento and San Joaquin rivers.	• Existing and new flow monitoring sites. • New turbidity, EC and water temperature stations. • Daytime fish catches in a stationary Kodiak or Midwater trawl over a ~12-hr tide cycle (Attachment C in Appendix C)).
4	Maintaining a low turbidity region in Old and Middle Rivers reduces adult delta smelt salvage.[2]	• Turbidity • Observed Salvage • Model results for salvage	• Existing and new flow stations • Existing and new water quality stations. • Vessel-based turbidity monitoring down the Old and Middle Rivers • Salvage
Dispersive Mixing and Larval and Juvenile Delta Smelt			
5	Open-on-ebb operations increase dispersive mixing between the south-central Delta and lower San Joaquin River through Franks Tract-False River.	• Net flows in Old and Middle Rivers • Calculate salt flux decomposition in False River west of Franks Tract or possibly measure bromide time series (Attachment B in Appendix C) • Salinity and salts gradients from OR –FT-FR-SJR. • Fingerprinting estimates based on bromide time series.	• Existing and new flow monitoring stations. • Additional field data to fingerprint water source (e.g. bromide sensor)

1. RMA hydrodynamic model would run trials run over 1-2 weeks with controllable and stable net flows and exports. Test on same tide phase for both. Neap and spring >=twice each, learning as we go. First measure with gates open, then a few days with the gates operating (closed for all or some portion of 24 hours). This is not a pulse flow test.
2. Test is for no difference in mean flow for model runs with gates open and a difference when Project is operating, with multiple model runs. Do mean observed flows fall in range of predicted net flows, i.e., predictions are correct? Assume that the distribution of random variation under historic conditions applies to the test conditions. Use appropriate tests taking into account autocorrelation if necessary

The two hypotheses developed regarding flow and turbidity effects of gate operations include:

- 2-Gates Project operations, coordinated with OMR flows restrictions, can control net flows in Old River to achieve a predictable balance of flows between Old and Middle Rivers.
- 2-Gates Project operations, coordinated with OMR flow restrictions, can balance net flows between Old and Middle Rivers to maintain a low turbidity region in Old and Middle Rivers.

Hypotheses also have been developed regarding the physical migration cues for pre-spawning adult delta smelt and the effectiveness of the project in reducing adult delta smelt entrainment:

- Migration of pre-spawning adult delta smelt from the Suisun Bay into the Delta and freshwater habitats occurs when initial winter storm events increase Sacramento River turbidity in the Delta to above a threshold of 12-15 NTU.

Maintaining a low turbidity region in Old and Middle Rivers reduces adult delta smelt salvage at the export facilities.

The following hypothesis was developed to examine Project effects on a hydrodynamic process for juvenile delta smelt transport:

- Opening the Old River gate on ebb-tide and closing it on flood creates net circulation downstream on Old River and upstream on Middle River that increases mixing between Franks Tract and western San Joaquin River.

Table 2-1 presents these hypotheses, the metrics that will be used to evaluate the hypotheses, and the data sources used to describe the results of the evaluations. Further details on experimental design and monitoring to provide information about metrics are provided in Appendix C. Science & Monitoring Plan.

2.2 STRUCTURAL COMPONENTS

The Project involves the installation and operation of two gate structures mounted on commercially available cargo barges, one in Old River and one in Connection Slough. A plan view of the design at both the Old River and Connection Slough sites is shown on Figures 2-8 and 2-9, respectively. A conceptual view of the Old River operational gate system, showing gates opened and closed, is shown in Figure 2-10. Detailed design plan views, cross-sections, and layouts for the Old River and Connection Slough sites are included in Appendix D.

2.2.1 Gate Structures

Approximately 175-foot wide butterfly gates will be mounted on steel barges and ballasted into place on prepared beds in both the Old River and Connection Slough channels. The barges will be further held by large rocks (lock rock) placed along each side to provide additional resistance to lateral forces from tidal flows, and they will be keyed into sheet pile dikes.

The butterfly gate design consists of double gates that are supported on a center pivot to allow vessels to pass through the gates when they are open. The gates are designed to accommodate commercial and large private vessel traffic typical for the Old River and Connection Slough locations. When open, the Old River gates will provide a 75-foot wide navigation opening, which is consistent with the navigation opening provided at the BNSF Railway Bridge, located just south of the Old River site, and the Connection Slough gates will provide a 60-foot opening. Both sites will include boat ramps to provide passage for smaller recreational boats (a maximum of 24 feet and 10,000 pounds) when the gates are closed.

The gate top elevation will be +6.6 feet, the top of the sheet pile dikes will be +6.6 feet, and the top of the levees are set at 10.5 feet. The gate sill (barge deck) elevation will be at -19 to -20 feet at the Old River site and -12.3 feet at the Connection Slough site. An operator house will be constructed on each gate barge.

The barge supporting the gates at the Old River site will be between 200 and 280 feet long and between 50 and 105 feet wide. At the Connection Slough site, the barge would be between 175 and 202 feet long and between 50 and 75 feet wide. The hull depth of the barge at the Old River site would be between 12 and 18 feet, and between 12 and 16 feet at the Connection Slough site. The barges would be designed with abutments to join the sheet pile dike at both ends. Barges would be sunk onto a prepared foundation at each gate location. The foundation would be prepared by dredging the peat beneath the foot print of the barge and refilling it with crushed rock. The bedding layer would range from 2 feet thick at Old River to 6 to 10 feet thick at Connection Slough. Up to 5,700 cubic yards of rock fill would be used at Old River, and up to 15,300 cubic yards would be used at Connection Slough.

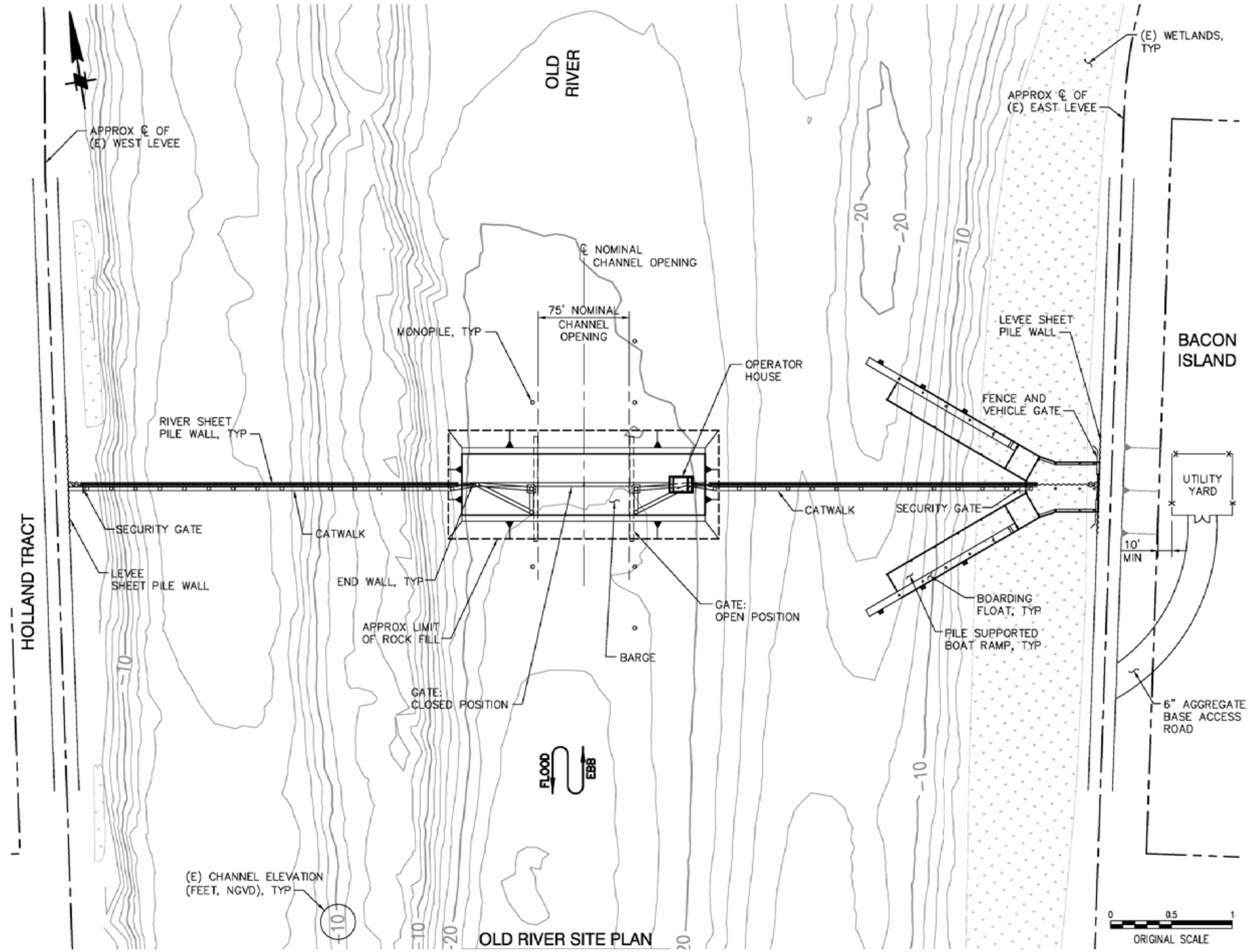


Figure 2-8 Old River Site Plan View

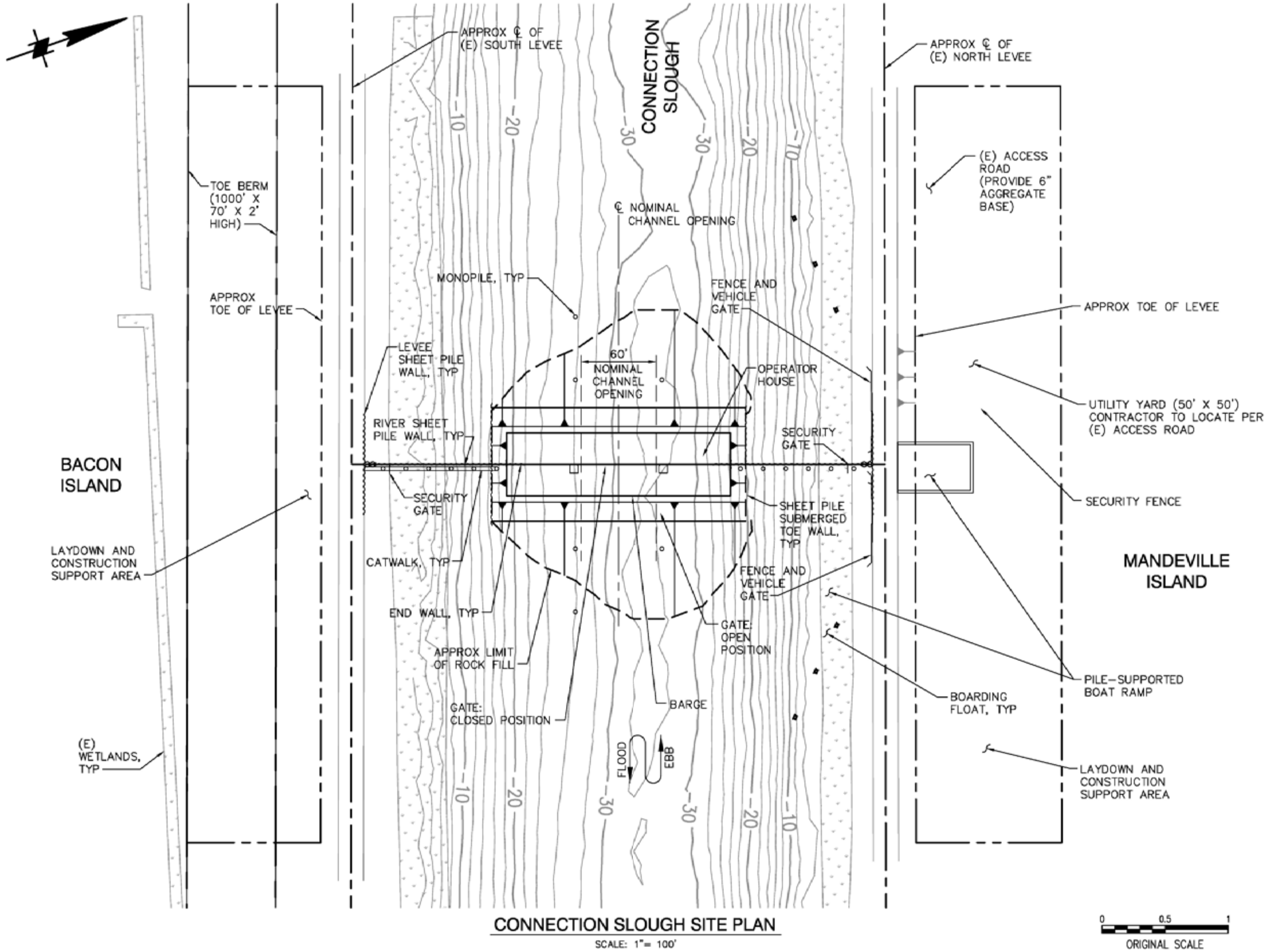
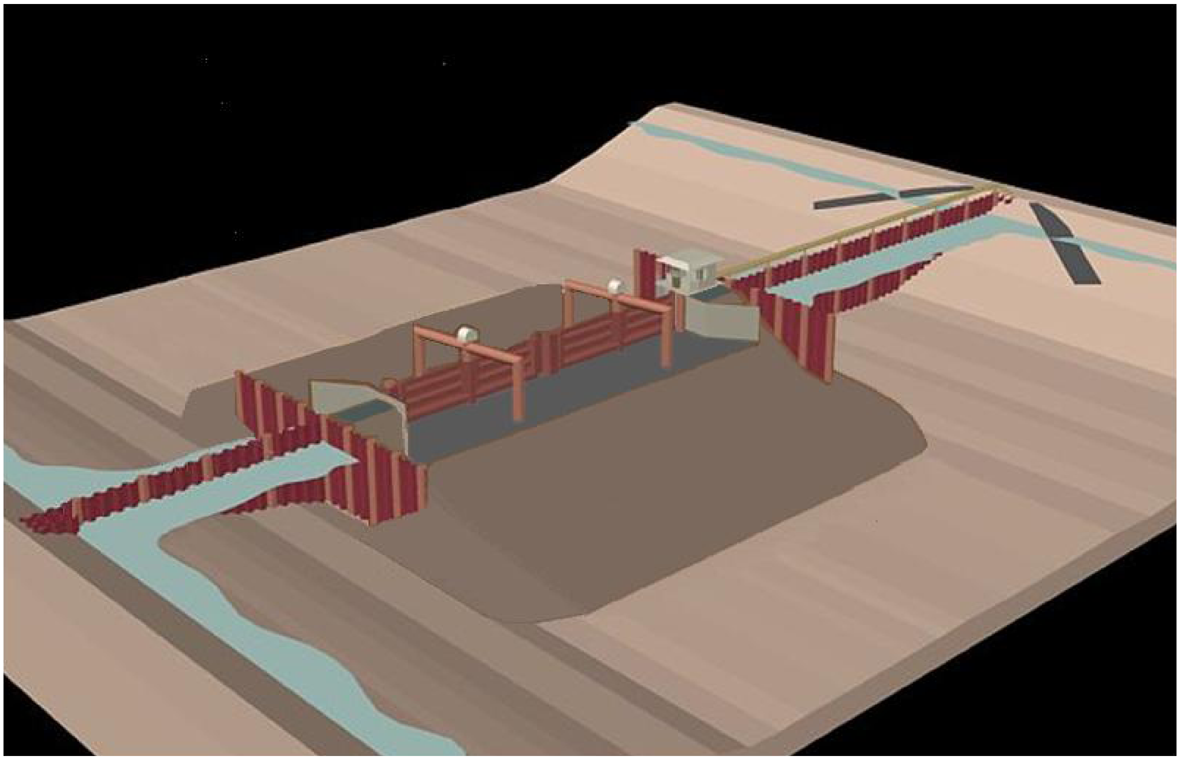


Figure 2-9 Connection Slough Site Plan View



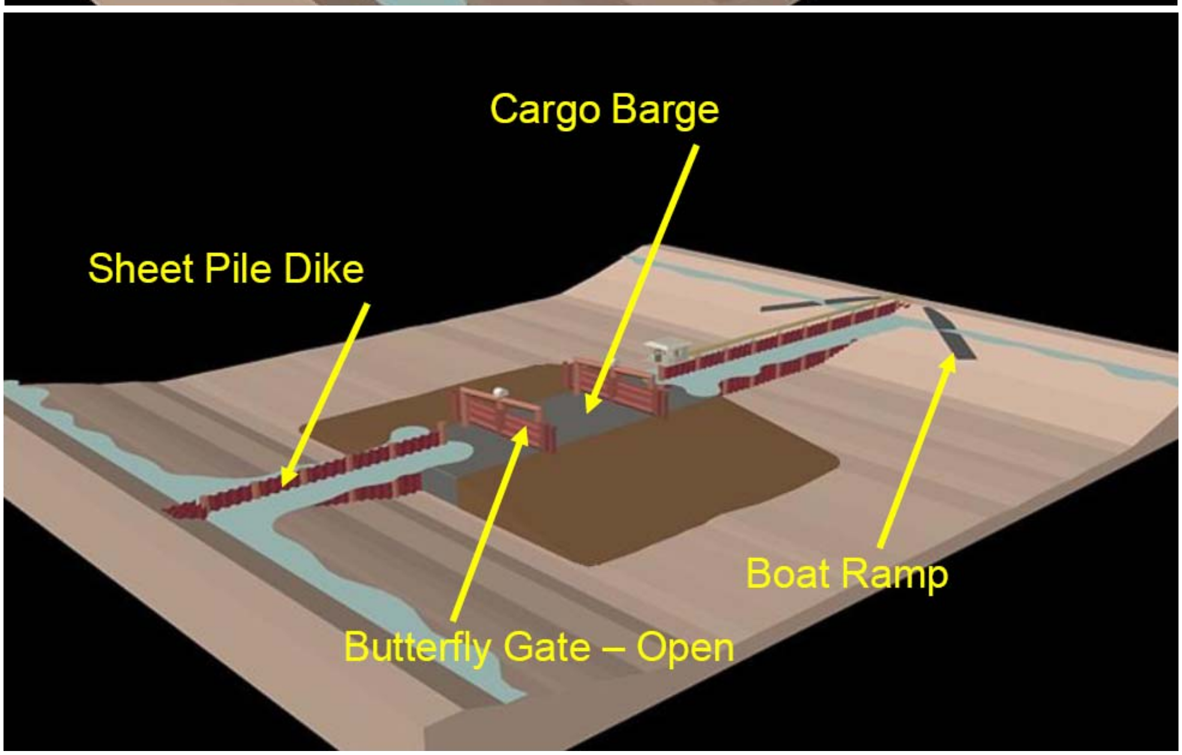


Figure 2-10 Old River Slough Site Conceptual View Showing Gates Closed and Open

2.2.2 Sheet Pile Wall

A sheet pile wall will be placed between the gate structures and the levees that line the Old River and Connection Slough channels. At the Old River site, which is approximately 800 feet wide, about 300 feet of sheet pile dike will be placed at both ends of the barge, extending to the adjacent levees. At the Connection Slough site, which is approximately 400 feet wide, about 100 feet of sheet piles will be placed at both ends of the barge to anchor it to the river banks. The sheet pile wall will extend into the levees on both sides of the channel. A 50-foot perpendicular sheet pile dike will be installed into levees at each end of the sheet pile walls for approximately 25 feet on either side of the wall. Tying the sheet pile wall into the levee will require removal of a strip of existing levee slope protection material. At the gate barge end, a special end piece fabrication will be required to facilitate barge placement tolerances. The sheet pile wall will be constructed without excavating existing river bed peat material, thus minimizing the risk of seepage through the existing levees and the need for constructing cut-off walls within the existing levees.

Preliminary analysis has been performed to check the required depth of embedment and estimate the strength criteria for the sheet piles acting as the barrier between the gate structure and the levee. Based on this analysis, steel sheet piles in lengths of 60 to 70 feet will be transported to the site on a barge and vibrated into the underlying sand layer by barge mounted equipment. To complete the sheet pile wall, the sheet piles will be supported by 36-inch diameter king piles, set on approximately 20-foot centers at both locations (see Appendix D, 95 Percent Design).

2.2.3 Boat Ramps

Boat ramps (and associated small boat trailers and trucks) will be provided to facilitate portage of small boats around the closed gates when the gates are closed. Two pile-supported boat ramps will straddle the sheet pile walls at each of the two sites. Boarding floats will be provided alongside the ramps to facilitate staging of the boat launch and retrieval operation. The boat ramps will be tied into the existing levee roads and will require widening of the levee area to provide sufficient maneuvering space to accommodate launching and retrieving boats. Appendix D Sheets C-1 and C-31 illustrate the amount of ground surface required for installation of the boat ramps and gate structures for the Old River and Connection Slough sites respectively.

2.2.4 Levees

The levees will be strengthened by addition rip rap on either side each levee on either end of the gates for a distance of approximately 50 feet using sheet piles and rock consistent with the agreement with Reclamation District 2025 associated with Holland Tract, Reclamation District 2028 associated with Bacon Island, and Reclamation District 2027 associated with Mandeville Island.

2.2.5 Mechanical and Electrical Components

The barge will incorporate the piping and valves necessary for ballasting and de-ballasting operations, thus allowing the barge to be removed if necessary. The pumps, compressors, and generators for installation of the barge will be provided on a separate construction support barge. Once the barge is submerged, the construction support barge will be removed.

Power for the electrical system will be provided by Pacific Gas & Electric (PG&E), using the nearby power line at each site; or pending the PG&E interconnection, a skid-mounted diesel generator located on an upland area next to the existing levee will be used. The generator skid will be a self-contained system with a diesel-powered generator, starter batteries, fuel tank, spill containment and other components. Should the system need to run continuously for an extended period, an additional fuel tank skid and fuel pump could be required.

Cabling will transmit the electrical power from the PG&E pole or the generator to the operator house. The operator will use levers on the control console to open and close the gates. The operator house will include outlets, fluorescent lights, and a wall-mounted heating, ventilating, and air-conditioning unit. The operator will control three sets of flood lights, allowing the eastern and western gates and boat ramp to be illuminated. These lights will be shielded and directed toward the facilities. No bare bulbs will be used. Channel marker lights will be U.S. Coast Guard (USCG) approved.

2.2.6 Navigation Markers

Signage will 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 will be established to keep small 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 small 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 will 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.

2.2.7 Fender System

A fender system will protect the gate structures from potential vessel impact. The fenders will consist of six steel mono-pile dolphins constructed at each site. Three fenders will be placed at the sides of the navigation channel on the upstream and on the downstream approaches to the gates approximately 40 feet from the face of the barge. Commercial vessels and recreational boats intending to pass through the gates will enter the channel aligned with the gate opening and will not change direction until they have passed through the gate structure.

2.3 PROJECT CONSTRUCTION

Construction of the gate structures will involve dredging the barge foundations and refilling them with crushed rock. Sheet pile dikes will be installed, and the barges then will be sunk to the foundations and keyed into the sheet pile walls. Rock will be added to the sides of the barges and at each end to lock the barges in place. Boat ramps will be constructed at each site and the existing levees will be widened to accommodate activities at the boat ramps. The Project will be built primarily from the water, using barges and other vessels within the river channels. Materials and construction equipment (e.g., pile driver) will be brought to the site by barges. Some construction also will take place from the levees; for example, boat ramps will be constructed on one adjacent levee at each gate site. The following describes the major construction practices that will be followed in greater detail.

2.3.1 Laydown and Construction Support Areas

Areas on Bacon Island and Holland Tract adjacent to the Old River site (measuring approximately 600 feet by 100 feet) have been identified for laydown and construction. Similarly, areas on Bacon Island and Mandeville Island adjacent to the Connection Slough site, (measuring approximately 600 feet by 140 feet) have been identified for laydown and construction. These locations would require clearing, grubbing, and grading per the contactor's recommendations.

An area of approximately 12 acres on Holland Tract also is available for temporary storage of construction materials, such as rock, if additional storage is needed.

Land areas will be needed for construction of the gate structures, tie-in of the sheet pile walls to sheet piles in the levees, boat ramps, and to strengthen the levees at the gate locations. They also will be needed for any other land-side facilities such as generators, equipment storage, and for parking by construction personnel and operations staff. Laydown areas will be required for the initial staging of rock and sheet pile used on the levees. The general geographic areas in which rights are expected to be needed for construction and laydown are shown in Figures 2-2 and 2-3. The dredged material disposal area on the Bacon Island side of Connection Slough, located as required by Reclamation District 2028, is illustrated in Figure 2-3 and in Appendix D, Sheet C-81.

2.3.2 Dredging and Rock Placement

Prior to the installation of the barge-mounted gate system, a barge-mounted clamshell dredge will remove the unstable peat material from the channel bottom, and a gravel sub-base foundation will be installed. Dredging will extend to a depth of between -33 and -40 feet at the Old River site and -35 feet at the Connection Slough site. Dredging will extend 12 feet fore and aft of the barges and 20 feet on the sides, affecting from 25,200 to 55,200 square feet at Old River and 22,800 to 32,700 square feet at Connection Slough. The volume of dredged material is estimated at between 11,500 and 42,800 cubic yards at Old River and between 7,500 and 11,300 cubic yards at Connection Slough.

Dredged material will be disposed of locally on Bacon Island near the junction of Middle River and Connection Slough, either along the toe berm or the disposal area (Figure 2-3). If additional storage area is needed, some of the dredged material will be disposed of at the Holland Tract alternative storage/disposal site (Figure 2-3). Dredged material from the Connection Slough site will be sidecast over the levee into the disposal area on Bacon Island. Material from Old River will need to be placed on a barge, moved to the disposal area, and offloaded over the levee at the Bacon Island disposal site; alternatively, if insufficient space is available on Bacon Island, the dredged material will be trucked to the Holland Tract storage/disposal site. The disposal area(s) will be surrounded by a low berm in order to contain any runoff.

2.3.3 Sheet Pile Walls

Sheet piles will be installed using vibration driving techniques, although king piles will be installed using an impact hammer. The sheet pile dike would tie into the levee and would require removal of vegetation and riprap along a 75-foot length of levee on each side of each site.

2.3.4 Gate Barge Construction and Installation

Assembly and fabrication of the gate structures and electrical and mechanical installation will be carried out by the contractor. The converted barges will then be floated to the Old River and Connection Slough sites. Sheet pile installation, dredging work and bedding rock placement will have been completed prior to gate barge arrival at the sites. The barges will be cleaned prior to their placement in the channels, and residual oils, lubricants, and other contaminants will be removed. The barges will then be ballasted to the prepared sites on the river bottom, fendering dolphins will be installed, and rock fill work will begin. Guide piles may be installed to help position the barge during the ballasting / grounding procedure, but these piles will be removed once the barge is in place.

2.3.5 Construction Power Supply

Power for facilities installation will be provided by PG&E although stand-alone generators may be used at each Project site as a back-up. The need for temporary power for construction will be needed only for land-based welding or small winches or hoists to position barrier sheet elements. Most, if not all, welding and sheet pile placement will be from a waterside barge.

2.3.6 Access

Most of the construction (e.g., dredging, placement of rock, and driving sheet pile) will be done from barges. However, it may be necessary to deploy earthmoving equipment on the islands to install levee buttresses. Figure 2-3 shows the access routes that will be needed from public roads to the Project sites. Movement of earthmoving equipment during construction is expected to be limited to the construction/laydown areas shown above. Truck access to the dredged material disposal site will be within the Connection Slough and Old River work areas.

The Connection Slough and Old River sites are navigable from the San Joaquin River. The Old River site is accessible by land from Holland Tract and Bacon Island. The west Old River levee is on Holland Tract and is accessible by road by proceeding through the town of Knightsen and crossing the Delta Road Bridge on Delta Road. The Old River project site is then accessed via a private road. The east side of the Old River site is accessible via a private road crossing Bacon Island from east to west about 2 miles north of the Middle River Bridge and approximately 10 miles from State Route (SR) 4. Part of this access road on Bacon Island is unpaved. The Connection Slough site can be accessed by Bacon Island Road. The Mandeville Island side of the Connection Slough site is accessed via a bridge crossing Connection Slough (Figure 2-3).

Any levee roads, private or maintenance roads or other access roads that are damaged as a result of construction equipment or truck use will be restored to pre-construction conditions once construction is completed. Additionally, it may be necessary to grade and apply gravel to the Holland Tract access road. It may be necessary to grade and gravel to the Holland Tract access road and to the unpaved part of the private road on Bacon Island. It also may be necessary to pave small sections of Bacon Island Road between SR 4 and Connection Slough to ensure safe passage of land-based construction equipment.

2.3.7 Vessel Passage during Construction

The contractor will maintain vessel access during construction. Notices of construction will be posted at local marinas and in the Local Notice to Mariners. Navigational markers will be used to prevent boaters from entering the immediate construction area, and speed limits will be posted. Safe vessel passage procedures will be coordinated with the Sector Waterways Management Division (USCG Station Yerba Buena Island) and California Department of Boating and Waterways (Cal Boating). An educational program will be implemented to inform boaters of the purpose of the Project, expected duration of installation activities, schedule of gate closures, and operational characteristics of the gates. The program will include notices in local newspapers and boater publications as appropriate; notices also will be posted at local marinas and boat launches and on the Project website (http://www.baydeltalive.com/?page=Projects&subpage=Project%20Page&view=Project%20Page&id=563).

2.3.8 Construction Schedule

The 2-Gates Project facilities will be installed in the fall of 2009 during the window for in-channel activities established by the regulatory agencies to protect sensitive aquatic species. This window extends from September 1 until November 30. Construction work at the Old River and Connection Slough sites will be completed in about seven weeks. Fall construction will minimize impacts on sensitive aquatic and terrestrial resources as well as avoid peak recreational use periods (Table 2-2). Site preparation prior to the placement of the barges will require about one month. This includes dredging the foundation areas of the barges, placing rock in the dredged area, and installing sheet piling. The barges will be placed at the end of the site preparation period; approximately about two weeks will be required to install each barge. Sheet pile installation will be conducted during daylight hours only; dredging will be conducted 24 hours per day, as will rock placement and gate barge installation.

Table 2-2 2-Gates Project Construction Timing and Duration

Construction Activity	Construction Timing	Construction Duration
Construction of sheet pile wall, dredging, installation of barge foundation rock	October-November 2009	Five weeks
Installation of barge with gates and anchor rock	November 2009	Two weeks

2.4 PROJECT OPERATIONS

The Project facilities will be operational immediately upon the completion of construction, and the gates will be operated between December and June for a five year period expected to begin in 2009from 2009 to 2014. Gate structures including sheet pile walls will remain in place with gates in the open position from July through November of each year. A gate operator will be present at each site 24 hours a day, seven days a week, during the operational period and will open and close the gates in response to fish protection criteria as well as to accommodate passage of commercial or emergency vessels and large recreational boats. The operator also will coordinate the operations necessary for passage of small recreational boats using the levee boat ramps when the gates are not otherwise open or are open for commercial approved large vessel traffic.

The protocols for operating the gates are based on our conceptual understanding of factors affecting smelt entrainment, as described earlier, and refined through hydrodynamic and behavioral modeling. Operational parameters and actions are described below, with more detail provided in the Operations Plan (Appendix B). Gate operations will begin as early as December each year occur when smelt distributions are located north and west of the Project facilities as determined by flow, turbidity and water temperature, and biological data collected by Project monitoring.

The Project will be operated by Reclamation or its designee. The 2-Gates Project is designed to be operated in conjunction with and in coordination with OMR flows prescribed through the USFWS and NMFS OCAP BOs (USFWS 2008, NMFS 2009). Project operations will take place in consultation with the SWG, DOSS, and the WOMT. in a manner that is consistent with the OCAP BOs, including the RPAs for OMR flow restrictions and the adaptive management process (Appendix B). Figure 2-11 illustrates the timing of Project operations and the most relevant RPA actions. The decision-making process and the Project's role within it are discussed further in Section 2.6 and the Operations Plan (Appendix B).

2.4.1 Hydrodynamic and Behavioral Models

A variety of models were developed by Resource Management Associates (RMA) to establish the Project concept and operational protocols (Appendix A):

- **Hydrodynamics and Turbidity.** These models (RMA2 and RMA 11) were used to simulate flow and turbidity patterns to identify opportunities for balancing flows in Old and Middle Rivers and controlling distribution of turbidity into the south Delta channels.
- **Delta Smelt Behavioral Model.** This model is based on a particle tracking model with assumptions (and associated uncertainties) regarding delta smelt behavior in response to water quality and flow gradients. The model output provided theoretical pre-spawning adult responses to flow and turbidity under existing and Project conditions, allowing refinement of different gate operational scenarios to optimize desired turbidity conditions.

Each of the models is described below, and further details are provided in Appendix A.

Month	2-Gates 1. Pre-spawning Adult Delta Smelt entrainment protection	2-Gates 2. Larval and juvenile delta smelt entrainment protection (dispersive mixing)	FWS Action 1 Adult delta smelt migration and entrainment (Part A - first flush)	FWS Action 2 Adult delta smelt migration and entrainment (Part B - extended protection)	FWS Action 3 Entrainment protection of larval delta smelt	NMFS Action IV. 2.1 Maintain SJR Inflow/Export ratio	NMFS Action IV. 2.3 Reduced exports to limit negative OMR flows depending on presence of salmonids
Dec	December – March Operate gates to maintain low turbidity zone in Old and Middle Rivers, until water temperature ≥12ºC or spawning detected.		December - March Limit exports to limit negative OMR flows (-2,000 to -2,500 cfs), until water temperature ≥12ºC or spawning detected.	December - March Limit exports to limit negative OMR flows (-1,250 to -5,000 cfs), until water temperature ≥12ºC or spawning detected.			
Jan							Jan 1 – June 15 OMR flow (15,000 to -2,500 cfs) until after June 1 water temperature at Mossdale ≥ 22ºC for 7 days.
Feb							
Mar							
		Early/mid March - March 31 Once temperature ≥12ºC or spawning detected, operate gates for dispersive mixing.			Early/mid March - June 30 Once temperature ≥12ºC or spawning detected, limit exports to limit negative OMR flows (-1,250 to -5,000) until June 30.		
April						April 1 – May 31 Maintain Vernalis Inflow/Export ratio depending on water supply parameters (interim 2009-2011) or depending on water year (long term 2012+)	
May							
June		June 1-30 Operate gates for dispersive mixing until temperature ≥ 25ºC					

Figure 2-11 A Summary of RPA Actions (FWS 2008 OCAP BO RPA 1 and NMFS 2009 OCAP BO RPA Action IV.2) and 2-Gates Operations

2.4.1.1 Hydrodynamic and Turbidity Modeling

RMA has developed and refined models of the Sacramento-San Joaquin Delta system (Delta model) utilizing the RMA finite element models for surface waters (Appendices A and C). The RMA models are a generalized hydrodynamic model used to compute two-dimensional depth-averaged velocity and water surface elevation (RMA2), and another model (RMA11) is a generalized two-dimensional depth-averaged water quality model that computes a temporal and spatial description of water quality parameters. RMA11 uses stage and velocity results from RMA2. The Delta model extends from Martinez to the confluence of the American and Sacramento Rivers and to Vernalis on the San Joaquin River. Daily average flows in the model are applied for the Sacramento River, Yolo Bypass, San Joaquin River, Cosumnes River, Mokelumne River, and miscellaneous eastside flows which include Calaveras River and other minor flows. The model interpolates between the daily average flows at noon each day. Delta Islands Consumptive Use (DICU) values address channel depletions, infiltration, evaporation, and precipitation, as well as Delta island agricultural use. DICU values are applied on a monthly average basis and were derived from monthly DSM2 input values. Delta exports applied in the model include SWP, CVP, Contra Costa exports at Rock Slough and Old River intakes, and North Bay Aqueduct intake at Barker Slough. Dayflow and Interagency Ecological Program (IEP) database data are used to set daily average export flows for the CVP, North Bay Aqueduct and Contra Costa's exports.

RMA ran a set of hydrodynamic, EC, and turbidity simulations to form the basis of the initial gate operations schedule. The modeling study evaluated how conditions change in the Delta under (1) historical conditions, (2) historical conditions operated under the OCAP RPAs, and (3) operated under OCAP RPAs with the Project. Historical simulations were run for the period between December and July for 1999-2000, 2002-2003, 2003-2004 and 2007-2008. These years were selected because they were the only ones with adequate data (i.e. turbidity) to support the analysis. Both the adult and larval/juvenile particle tracking analyses utilize the RMA Bay-Delta Model for hydrodynamics and water quality simulation and the RMATRK particle tracking model.

2.4.1.2 Delta Smelt Behavioral Modeling

Delta smelt distribution and entrainment was modeled with two distinct particle tracking techniques representing the adult life stage and the larval/juvenile life stages (detailed in Appendix A). Adult delta smelt are not well represented using passive particle tracking techniques because they are sufficiently strong swimmers to resist tidal flows by moving out of the current and into shoals or near the bed where velocities are low. Entrainment of adult delta smelt occurs during the period when the fish move upstream for spawning. Periods of peak entrainment are correlated with high turbidity resulting from storm flows in the area near the export pumping facilities. RMA developed a particle behavior model to simulate the movement of adult delta smelt during this period based on simulated distributions of salinity (represented as electrical conductivity, EC) and turbidity. Because turbidity is a key driver for the distribution of adult smelt, the optimum gate operation to minimize adult entrainment is based on controlling the extent of the turbidity plume into the south Delta channels of Old and Middle rivers (Figure 2-1).

Larval and juvenile delta smelt are considered small enough to be represented as passively transported particles. Initial evaluation of gate operations for minimizing larval and juvenile entrainment was performed by CH2M Hill (citation). In that study, the DSM2-PTM was used to evaluate potential entrainment for smelt monitoring locations around the Delta. In this analysis, a passive particle tracking methodology (developed by Dr. Edward Gross with Dr. Lenny Grimaldo [USBR] and Dr. Ted Sommer [DWR]) is used to represent the spatial and temporal distribution of larval and juvenile delta smelt. Optimizing gate operations to minimize larval and juvenile entrainment involves minimizing advective and dispersive transport from regions of the Delta where fish densities are highest.

2.4.1.3 Real-Time Forecast Modeling

The following summary outlines how a forecasting model will be used to guide gate operations using the initial gate operations described here as a starting point. This model is currently under development and will be operational when initial gate operations take place.

Effective real-time forecasting requires knowing initial water quality and flow conditions, acquiring and interpreting delta smelt survey and salvage data, operations forecasts, and timely agency interaction. Forecasts will utilize the most recent field observations of delta smelt distribution and density; and forecasted estimates of inflow, inflow water quality, and operations. For each forecast period, several simulations may be performed using alternative estimates of future conditions. An initial set of forecast simulations will be performed using best estimates of future operations provided by Reclamation and DWR system operators. Upon review of delta smelt distribution and entrainment estimates by the SWG, a second set of forecast simulations may be performed with revised future operations with the objective of identifying operations that reduce expected delta smelt entrainment.

2.4.2 Gate Operation Protocols

The 2-Gates Project operating plan that is sufficiently flexible to adapt to real-time monitoring and predictive hydrodynamic, water quality, and delta smelt behavior modeling (Appendix B). DSM2 modeling results have shown that the operational effects of various measures on entrainment are strongly influenced by the initial distribution of delta smelt and relatively short duration hydrodynamic conditions in winter and spring. The following operating measures are described as examples of different operations under changing field conditions (Table 2-3). These operations may vary from time-to-time to provide information in support of in the field Before and After Control Impacts (BACI) activities described below.

Table 2-3 2-Gates Project Planned Operational Periods

Operational Period	Season	Operational schedule	Triggers, Off-ramps, and Notes
Pre-spawning Adult protection	Approximately December 1 to 15 – early March	Gates closed 0.5-2.5 hours daily.	• Gates will be operated to balance flows and maintain a low turbidity zone in Old and Middle Rivers. • Trigger for Operations - turbidity ≥ 12 NTU at San Joaquin River at Jersey Point. • Off-ramp- Water temperatures ≥ 12 degrees C.
Larvae and Juvenile Protection	Early March-March 31	Old River gate closed on flood tide (twice daily, about 10 hours total daily) and open on ebb and slack tides (~14 hours daily). Connection Slough gate closed about 20 hours daily and open during slack tide (~4 hours daily).	• Gates will be operated to maximize dispersive mixing. • Trigger for operations - water temperatures ≥ 12 degrees C or "spent" female smelt detected in fish sampling or salvage.
	April 1- May 31	Gates open at all times.	• Gates will not be operated during this period (Ref NMFS RPA IV 2.1)
	June 1-June 30	Old River gate closed on flood tide (twice daily, about 10 hours total daily) and open on ebb and slack tides (~14 hours daily). Connection Slough gate closed about 20 hours daily and open during slack tide (~4 hours daily).	• Trigger for operations – commence gate operations June 1 • Off-ramp - June 30 or when Delta water temperatures ≥ 25 degrees C. Gates open continuously until trigger monitoring commences in December. • Gates open on weekends for recreational boating.
No Project Operations	July – November	Gates open at all times.	• Gates will be open continuously to allow fish movement and navigation. • Monitoring for triggers for adult operations resume in December.

2.4.2.1 Pre-spawning Adults — December through March

The Old River and Connection Slough gates will be operated when turbidity concentrations ≥ 12 NTU begin to appear at the region of influence of the 2-Gates, defined here as San Joaquin River at Jersey Point. Hydrodynamic modeling results indicate that the gates will be operated to balance flow to manage turbidity and adult delta smelt distributions, generally within the region of influence of 2-Gates. Behavioral modeling has shown that the 2-Gates Project, in conjunction with OMR flow restrictions, is effective in maintaining the turbid conditions linked to pre-spawning movement of delta smelt within the region of influence of the gates, thereby reducing the entrainment of delta smelt at the CVP and SWP pumps. These actions may also control the initial distribution of larval and juvenile delta smelt in locations that reduce the probability of entrainment at the CVP and SWP export facilities.

Pre-emptive management of turbidity and associated adult delta smelt distributions will be accomplished using 2-Gates operations in conjunction with OMR flow restrictions established by the USFWS (2008) OCAP BO. Under this BO, the restriction of OMR negative flow rates will be triggered when turbidity is ≥ 12 NTU at three interior Delta sites (San Joaquin River at Prisoners Point, Jersey Point, and Victoria Canal). 2-Gates operations, however, will be triggered when turbidity is ≥ 12 NTU at Jersey Point. These operations will actively manage turbidity distribution farther downstream and several days earlier than will occur under the USFWS (2008) OCAP BO RPAs alone. Hydrodynamic modeling indicates that this action will be effective in restricting smelt passage and reducing entrainment in conjunction with the 2-Gates Project. The Project will be operated until the three-station daily mean water temperatures at Mossdale, Antioch and Rio Vista ≥ 12ºC, signaling the transition from adult to larvae/juvenile delta smelt management. This typically occurs between mid-February and mid-March.

The gates will be closed 0.5-2.5 hours daily in advance of a forecast high turbidity event. Triggers and off-ramps for gate operations are indicated in Table 2-4. Gate operations will occur within bounds of the OMR flow requirements during this period[2], which are average daily OMR flow[3] no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent). Forecast model simulations will be rerun in response to real-time turbidity data as needed to detect upcoming high turbidity events.

[2] RPA Action 2 OMR flow requirements do not apply whenever a three day flow average is greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and 10,000 cfs in San Joaquin River at Vernalis. Once such flows have abated, OMR flow requirements of the Action are again in place (FWS 2008b).

[3] OMR flows for this and all relevant actions will be measured at the Old River at Bacon Island and Middle River at Middle River stations, as has been established already by the Interim Order.

Table 2-4 Triggers for Adult Operational Period (December-March)

Trigger	Description	Threshold	Action
Turbidity	Turbidity (NTU) at various stations (1)	< 12 NTU @ JP	Monitor for trigger, no gate operations
		> 12 NTU @ JP AND <12 NTU in Old and Middle R	Commence gate operations
		> 12 NTU throughout Old and Middle River and central Delta	Cease gate operations, wait for turbidity to drop and equilibrate, recommence trigger monitoring.
Salvage	Delta smelt Salvage index -Calculated ratio of adult salvage to fall Midwater Trawl index (2)	Delta smelt salvage < salvage trigger	Continue with gate operations plan
		Delta smelt salvage > salvage trigger AND Turbidity > 12 NTU @ JP and <12 NTU @ OMR	Cease gate operations, consult with SWG, evaluate actions
	Salmonid catch index (3)	>10 fish/day Nov-Feb >15 fish/day Mar-April	Consult with DOSS, evaluate actions
	Condition of female delta smelt	Spent female found in salvage	Cease adult gate operations, and Shift to juvenile gate operations
Temperature	Water temperature at 3 stations (4)	Temperature >12°C	
Spring Kodiak Trawl	Condition of female delta smelt	Spent female detected in SKT	

SWG – Smelt Working Group, DOSS – Delta Operations for Salmon and Sturgeon Technical Group
1. Turbidity measured at JP (San Joaquin River at Jersey Point) and several stations in Old and Middle Rivers
2. Delta smelt salvage trigger from FWS OCAP BO, Attachment A (FWS 2008).
3. Salvage index for juvenile salmon from NMFS OCAP BO,RPA Action IV.3, p. 652-3 (NMFS 2009)
4. Water temperature three station daily mean at Mossdale, Antioch, and Rio Vista.

2.4.2.2 Larvae and Juveniles — March through June

The 2-Gates operations for larvae/juvenile smelt will take place from March through June except during April and May, which are the months when San Joaquin River inflow-export ratios established in the NMFS OCAP BO are in effect. In March and June, the gates will be open on ebb tides and closed on flood tides for the protection of larvae and juveniles. During the San Joaquin River inflow-export period, the gates will remain open. Both 2-Gates operations and OMR restrictions will be governed by the following two triggers (Table 2-5):

- Based on the real-time monitoring of hydrodynamic conditions, 2-Gates operations and OMR restrictions for larvae/juvenile delta smelt will be imposed, in consultation with the SWG, DOSS, and the Water WOMT, when the three-station daily mean water temperatures at Mossdale, Antioch and Rio Vista are ≥ 12ºC, signaling a transition from adult to larvae/juvenile delta smelt management actions.
- 2-Gates operations and OMR restrictions will be in effect, consistent with boundary conditions of OMR discretionary operations, until June 30 or until the daily average temperature reaches 25ºC for three consecutive days at Clifton Court Forebay.

Daily gate operations under this scenario will involve (1) the Old River gate closed about 10 hours per day on flood-tide and open on ebb-tide (including slack-tides) about 14 hours per day, and (2) the Connection Slough gate open about 4 hours per day on slack-tides. The gates will remain open during April and May. During June, the gates will be open on weekends to facilitate vessel passage.

Table 2-5 Triggers for Larval and Juvenile Operational Period (March and June)

Trigger	Definition	Threshold	Action
Temperature	Water temperature at 3 stations (3)	Temperature >12ºC	Start gate operations for dispersive mixing
		Temperature >25ºC	End operations for the year, Leave gates open
Dates	Period for juvenile operations	April 1-May 31	Suspend juvenile gate operations, Open gates for salmonid outmigration
		June 30	End operations for the year, Leave gates open
Salvage	Delta smelt Salvage index -Calculated ratio of adult salvage to fall Midwater Trawl index (1)	March: Adult concern level June: 0 (zero)	Consult with SWG, review ops, evaluate actions
	Salmonid catch index (2)	>15 fish/day Mar-April	Consult with DOSS, review gate ops, evaluate
20 mm survey	Distribution of delta smelt	Delta smelt # in East Delta elevated	Consult with SWG, evaluate whether hydrodynamics will carry out or to south
Acoustic tagging	Distribution of juvenile salmonids	Mokelumne salmon in south delta	Consult with DOSS, review gate ops, evaluate actions

SWG – Smelt Working Group, DOSS – Delta Operations for Salmon and Sturgeon Technical Group
1. Delta smelt salvage trigger from FWS OCAP BO, Attachment A (FWS 2008).
2. Salvage index for juvenile salmon from NMFS OCAP BO,RPA Action IV.3, p. 652-3 (NMFS 2009)
3. Water temperature three station daily mean at Mossdale, Antioch, and Rio Vista.

2.4.2.3 July through November

The gates will not be operated from July through November, and will remain in a fully open position. Delta smelt are not found in the Delta once temperatures reach 25ºC or until their up-estuary migration begins in December therefore protection from entrainment and salvage are not needed.

2.4.2.4 Vessel Access

The lead agencies will keep the Sector Waterways Management Division (USCG Station Yerba Buena Island) informed about the Project, so that relevant information regarding gate operations, including methods of vessel passage and the expected closure schedule is included in the Local Notice to Mariners and posted a local marinas. As noted in Section 2.3.7, an educational program will be implemented to inform boaters of the purpose of the Project, scheduled closures, and operational characteristics of the gates. The USCG also will update navigation charts as appropriate. Details regarding the anticipated schedule for gate openings and closures are included in Table 2-3.

Gate operators will staff the gates 24 hours a day, seven days a week while the gates were being operated. Their phone numbers will be made available to emergency service providers, including the USCG and Sheriff's Departments, and to local farmers and other commercial vessel operators. The gate operators will open the gates as needed for emergency situations and to allow access by commercial vessels (commercial vessel operators will be requested to notify the gate operators one hour before access is needed). Small recreational vessels up to 24 feet in length and less than 10,000 pounds will be allowed to portage around the 2-Gates facilities by using the boat ramps and small boat trailer facilities that will be provided. As described above, two pile-supported boat ramps will straddle the sheet pile walls at each of the two sites.

2.4.3 Hydraulic Considerations for Flood Events

Under normal water conditions, the gates will not be submerged completely because the gate frames rise above the gates and will be visible under most water stages. During large flood events, the sheet pile wall will be over-topped, but all in-channel structures will be designed to withstand over-topping. The gates will be open during flood events and will accommodate 100-year flood flows with an approximately 0.1-foot change in flood stage elevation compared to existing conditions.

The gates are designed to operate with up to a 3-foot maximum surface water differential elevation on either side of the gates; however, because of high water velocities that would be generated at this water stage differential, they will only be operated at up to a differential of 1.5 feet.

2.5 MONITORING AND SPECIAL STUDIES

The 2-Gates Project includes a monitoring and special studies program that will provide:

- Information for efficient Project gate operation decisions.
- Data to test hypotheses and reduce uncertainties regarding delta smelt responses to Project gate operations behavior, preferred habitat and life histories.
- Data to allow verification and testing of the models for future evaluation of operational changes.
- Data on the changes in flow, turbidity and other variables to evaluate the effects of Project operations.
- Data to evaluate potential Project effects on other species of interest (e.g., predation risk at gate structures, movement of salmonids and sturgeon).
- Guidance for adaptive modifications of project operations and structures.

This monitoring plan is presented in Appendix C. The plan incorporates several special studies (and associated monitoring) required to examine the physical processes and delta smelt response concepts underlying project design (Attachments to Appendix C, Science & Monitoring Plan).

In order to understand the effects of 2-Gates Project operations on hydrodynamic processes, a network of fixed-site sampling stations will be placed at key locations throughout the Delta (Appendix C). These stations either coincide with or will augment the network of existing Delta monitoring stations (Figure 2-12, Table 2-6). These stations will monitor fluctuations of water quality constituents over time in response to Project operations, including turbidity, salinity, and chlorophyll (Chl-a). Flow will be measured at the same locations. These data will show how Project operation alters exchanges between regions in the Delta through key channels.

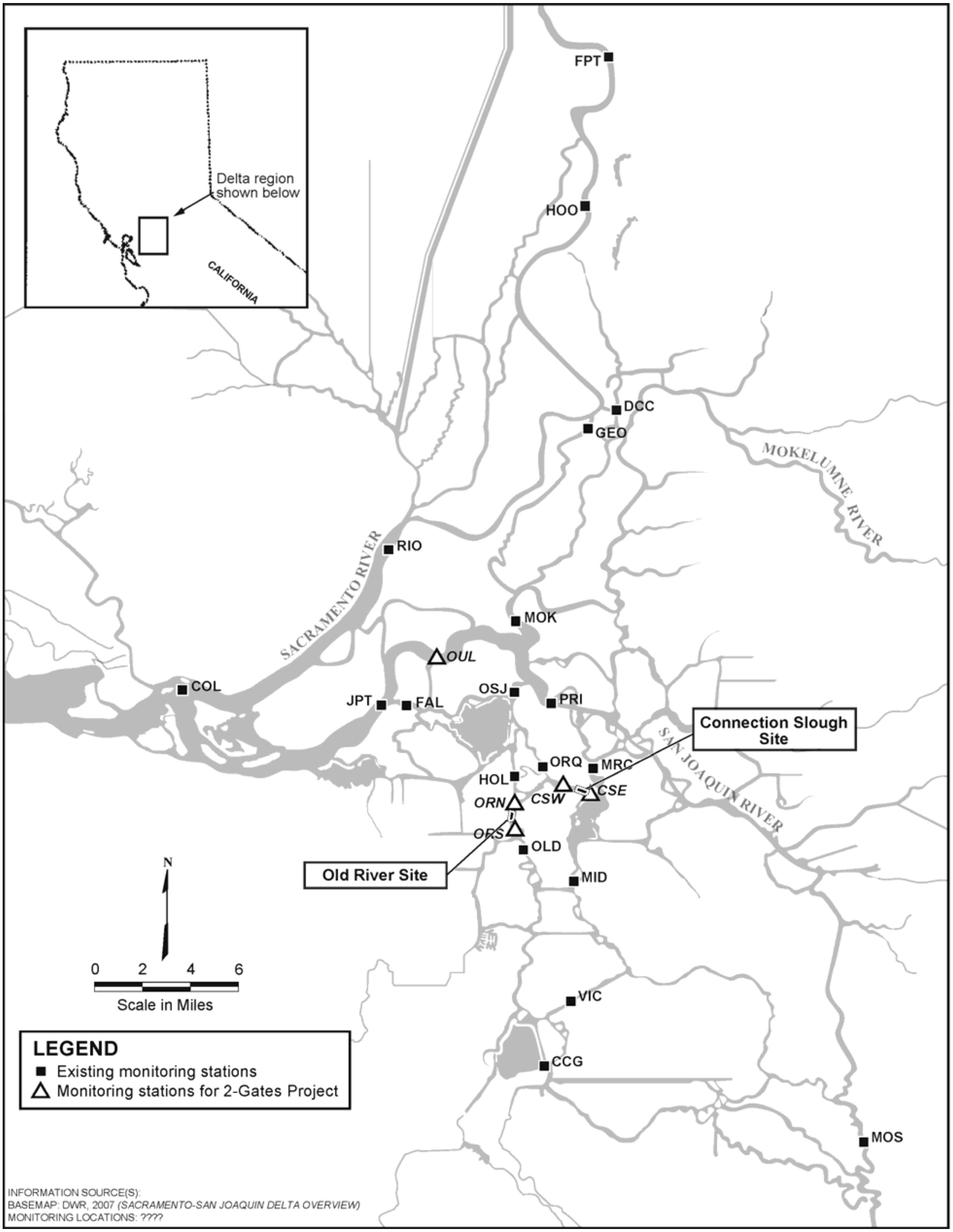


Figure 2-12 Locations of Existing DWR, Reclamation, and USGS Monitoring Stations in the Delta and Stations Added for the Project

These studies will be part of a larger monitoring and special studies program intended to provide a comprehensive picture of Project effects and effectiveness, particularly in regard to potential impacts on other listed species (Appendix C). This larger program was developed in collaboration with regulatory agency representatives (e.g., NMFS and USFWS) and system monitoring entities, such as the Interagency Ecological Program (IEP). The Project is in active discussion with the IEP and other entities that conduct monitoring and scientific investigations in the Delta These discussions include communicating the Project's data needs, assessing the long-term viability of programs the Project intends to rely on, and exploring options for providing Project resources (funding, equipment, contracted services, etc.) to sustain threaten programs and to support enhancements required for Project evaluation. With respect to juvenile salmon emigration studies, the Project is actively participating in the planning for VAMP-related studies, and has commissioned and received a proposal (Science & Monitoring Plan, Attachment C) for a full suite of investigations, including steelhead, to assess Project effects on juvenile salmonids emigrating from the Mokelumne River system. Finally, the Project is participating in the current review of recent "Action 8" northern Delta salmon emigration investigations and discussion of future studies. During these discussions the Project will be exploring opportunities for the Project to support future studies, and enhance them, as necessary, to address Project evaluation data needs.

Because of concerns regarding expanding biological sampling in the Delta, which can result in additional "take" of listed species, Reclamation and DWR have been collaborating on the development of a "trawl-cam." This trawl-mounted camera would harmlessly identify, measure, and count fish as they pass out the cod end of a trawl. Successful development of this sampling technique will provide the ability to expand sampling while not increasing take of listed species. The system is ready for field testing this spring and will be incorporated into the monitoring program for the 2-Gates project as appropriate.

The 2-Gates multi-parameter monitoring program will include:

- Identification of key potential Project impacts on smelt, salmon, steelhead, green sturgeon, and other species addressed by the Monitoring Program.
- Expansion of acoustic tag-based investigations on the survival and migration pathways of juvenile salmon emigrating through the Delta to address occurrence and survival in areas influenced by the Project.
- Expansion of the principal existing adult delta smelt abundance and distribution monitoring effort (IEP's Spring Kodiak Trawl Survey) to cover the full season of Project adult operations and to intensify sampling in the area affected by the Project.
- Temporal and geographical intensification of the principal juvenile delta smelt abundance and distribution monitoring effort (IEP's 20mm survey) to better assess juvenile smelt responses to Project operations.
- New large-fish acoustic camera monitoring stations at gate locations to assess potential predation effects on delta smelt and juvenile salmon and to assess the abundance and behavior of fish predators in the vicinity of the gates.
- Compilation of data from all relevant existing, expanded, and new monitoring programs, such that it is easily available for use by Project and agency staff and any other collaborators.
- Establishment of data synthesis and information dissemination infrastructures to feed adaptive management decision making regarding Project operations. It is expected that existing decision making bodies, such as the Smelt Working Group and Water Operations Management Team will be the principle recipients of monitoring information related to the Project.

Because the Delta is complex and always changing, controlled conditions are generally not possible. It is the intent to use the full body of information gathered through hydrodynamic modeling, and Project monitoring, special studies and field testing programs to draw inferences and conclusions about Project effects and effectiveness and expand our knowledge of the Delta. Further details on the experimental design and analytical approach are provided in the Science & Monitoring Plan (Appendix C)

2.5.1 Monitoring Stations for Flow and Water Quality

Hydrodynamics

Flow conditions in the Sacramento and San Joaquin Delta are monitored at 19 existing sites from the Sacramento River at Freeport and the San Joaquin River at Mossdale to Collinsville (Table 2-6 and Figure 2-12). The stations are maintained by DWR, USGS, and Reclamation. Five new sites will be added, including one at either side of each gate (see Figure 2-12).

Electrical Conductivity (EC)

EC in the Sacramento and San Joaquin Delta is monitored at 15 existing sites from the Sacramento River at Freeport and the San Joaquin River at Mossdale to Collinsville (Table 2-6 and Figure 2-12). The stations are maintained by DWR, USGS, and Reclamation. EC will be added to the existing Victoria Canal site and to five new sites as noted above.

Turbidity

Turbidity in the Sacramento and San Joaquin Delta is monitored at four existing sites from the Sacramento River at Freeport and Hood and at Jersey Point and Prisoner's Point on the San Joaquin River (Table 2-6 and Figure 2-12). The stations are maintained by DWR, USGS, and Reclamation. Turbidity will be added to eleven existing stations and to the five new sites as noted above (see Table 2-6).

Water Temperature

Water temperature in the Sacramento and San Joaquin Delta is monitored at five existing sites in the Central Delta (see Table 2-6 and Figure 2-12). The stations are maintained by USGS and Reclamation. Water temperature will be added to eight existing stations and to the five new sites noted above see Table 2-6).

Dissolved Oxygen

Dissolved Oxygen in the Sacramento and San Joaquin Delta is monitored at one existing site in the Victoria Canal (Table 2-6 and Figure 2-12). This station is maintained by USGS. Dissolved Oxygen will be added to twelve existing stations and to the five new sites discussed above (Table 2-6).

Chlorophyll-A

Chlorophyll-a in the Sacramento and San Joaquin Delta is monitored at one existing site at the San Joaquin River at Mossdale (Table 2-6 and Figure 2-12). This station is maintained by DWR. Chlorophyll-a will be added to twelve existing stations and to the five new sites noted above (Table 2-6).

Table 2-6 Existing and New Monitoring Stations and Parameters Supporting Operations of the 2-Gates Project.

	Agency			Measures					
Existing or New Monitoring Locations	USBR	DWR	USGS	Flow	Electrical Conductivity	Turbidity	Water Temp	Dissolved Oxygen	Chlorophyll -a
Existing Monitoring Stations									
Sacramento River at Rio Vista (RIO)			●	E	E				
Sacramento River at Freeport (FPT)		●		E		E			
Sacramento River at Hood (HOO)		●	●	E	E	E			
Sacramento River at Collinsville (COL)	●		●	E	E	N	N	N	N
Delta Cross Channel (DCC)			●	E	E				
Georgiana Slough (GEO)			●	E					
San Joaquin River at Jersey Point (JPT)		●	●	E	E	E	N	N	N
San Joaquin River at Prisoners Point (PRI)	●		●	E	E	E	E	N	N
False River (FAL)			●	E	E	N	E	N	N
Holland Cut (HOL)			●	E	E	N	E	N	N
Old River at Franks Tract (OSJ)			●	E	E	N	E	N	N
Old River at Quimby Island (ORQ)			●	E	E	N	E	N	N
Old River at Bacon Island (OLD)		●	●	E	E	N	N	N	N
Middle River at Bacon Island (MID)		●	●	E	E	N	N	N	N
Middle River at Columbia Cut (MRC)			●	E	E	N	N	N	N
Victoria Canal (VIC)			●	E	N	N	N	E	N
Clifton Court Gates (CCG)			●	E	E	N	N	N	N
San Joaquin River at Mossdale (MOS)		●		E	E	N	N	N	E
Mokelumne River at Andrus Island (MOK)			●	E					
New Monitoring Stations									
San Joaquin River at Oulton Point (OUL)					N	N	N	N	N
N of Old River Gate (ORN)					N	N	N	N	N
S of Old River Gate (ORS)					N	N	N	N	N
W of Connection Slough Gate (CSW)					N	N	N	N	N
E of Connection Slough Gate (CSE)					N	N	N	N	N
Additional proposed locations[1] – status unknown									
Sutter Island (SUT)				N					
Miner's Slough (MIN)				N					
Steamboat Slough (STM)				N					

Table 2-6 Existing and New Monitoring Stations and Parameters Supporting Operations of the 2-Gates Project.

	Agency			Measures					
Existing or New Monitoring Locations	USBR	DWR	USGS	Flow	Electrical Conductivity	Turbidity	Water Temp	Dissolved Oxygen	Chlorophyll -a
Walnut Grove A (WGA)				N					
Walnut Grove B (WGB)				N					
Cache Slough (CCH)				N		N			
Three mile Slough (TMS)				N		N			
Little Potato Slough (LPS)				N		N			
Dutch Slough (DCH)				N	N	N			
Turner Cut (TRN)				N	N	N			
Old River Ford (ORF)				N	N	N			
Grant Line Canal (GLC)				N	N	N			
Delta Mendota Canal (DMC)				N	N	N			
Old River at Byron Tract					N	N			
Old River at Woodward Island					N	N			
Middle River at Woodward Island					N	N			
Middle River at Victoria Island					N	N			

NOTE: "E" refers to existing monitoring activity; "N" refers to new monitoring activity added for 2-Gates Project.
1. Additional monitoring locations proposed by Jon Burau USGS in support of trigger monitoring and special studies (Attachments B and C in Appendix C Science and Monitoring Plan

2.5.2 Monitoring Programs for Aquatic Resources

Delta Smelt and Longfin Smelt

DFG monitors the distribution and abundance of adult delta smelt using the Spring Kodiak Trawl (SKT). Stations 809, 812, 815, 901, and 902 are in close proximity to the gates (Figure 2-13). Presence of adult delta smelt at these stations will indicate higher risk of entrainment. DFG's existing program monitors smelt monthly, beginning in February or March depending on conditions. The 2-Gates Project will require sampling twice a week beginning in December.

The distribution of larval and juvenile smelt is monitored by the DFG's 20 mm survey using the same stations as the SKT on a monthly basis. The 2-Gates Project will require sampling twice a month beginning in March.

Existing salvage monitoring data will be employed to evaluate periods of entrainment within the CVP and SWP project facilities to assess performance of the 2-Gates operations.

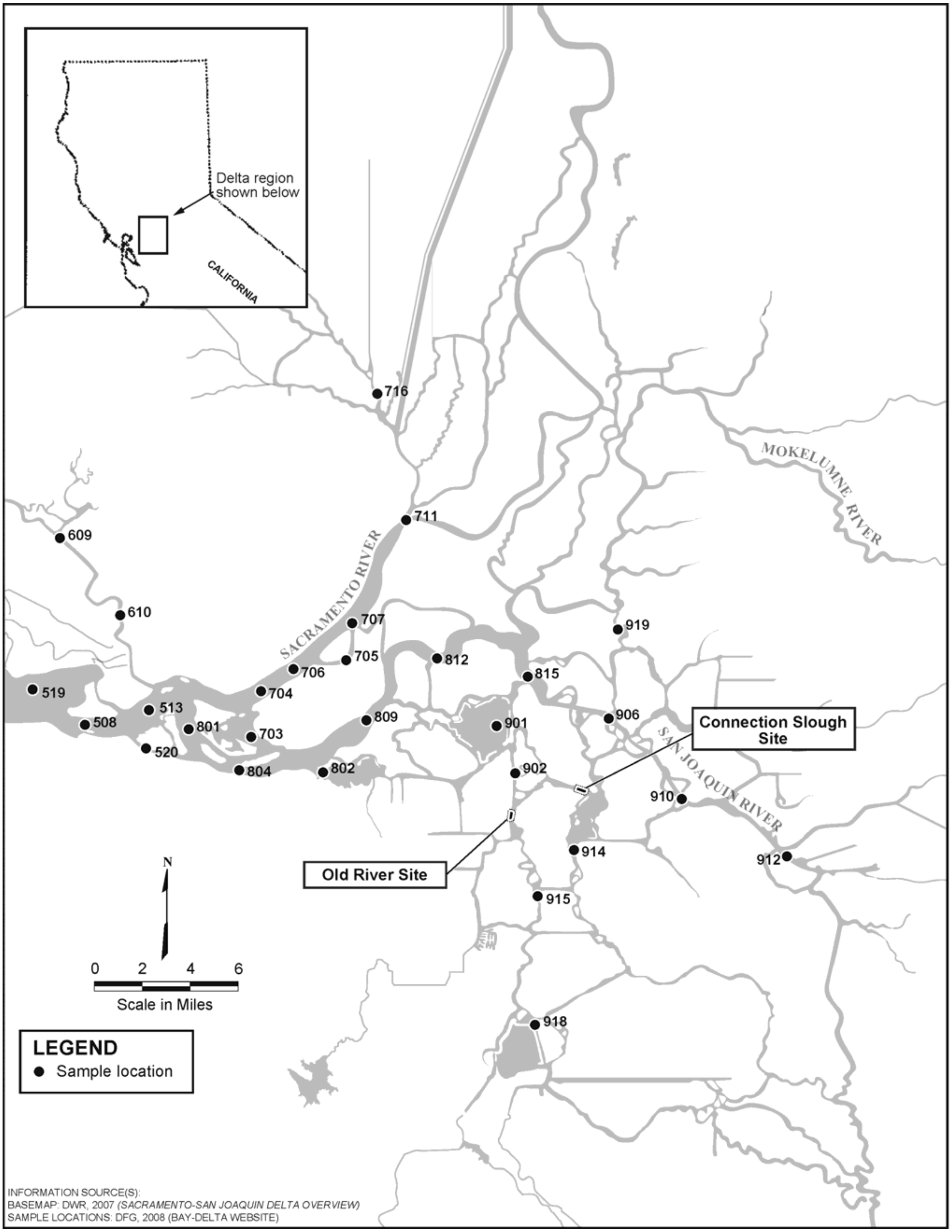


Figure 2-13 IEP Interior Delta Monitoring Stations for Fisheries Surveys

Salmon and Steelhead

Coordinated studies of acoustically tagged salmon and steelhead occurred on the Sacramento, Mokelumne and San Joaquin rivers in 2008-2009. These studies collectively released thousands of acoustically tagged fish that were individually tracked by remote receiving stations installed throughout the Delta (Figure 2-14). Some of these fish traveled to the vicinity of the gates and on to the fish salvage facilities. If similar studies are anticipated during 2-Gates Project operations, the plan will support additional acoustic tagging and remote recording sites on either side of each gate to better evaluate how salmon and steelhead move past the gate structures and into and through the central and south Delta.

Green Sturgeon

Very little information is available on how green sturgeon use the Delta, including what life stages are present and what areas of the Delta are used for feeding or rearing. Sturgeon are not taken in the ongoing netting operations but are collected at the CVP and SWP export facilities. This project may provide an opportunity to use fish collected at the facility by acoustically tagging and releasing them in the project vicinity. This will provide basic information on distribution of green sturgeon, at least during the time that the acoustic receivers are deployed during winter and spring for salmon and steelhead.

2.5.3 Stationary Trawl Study

As described in Appendix C the Science & Monitoring Plan, a special study to elucidate the behavioral response of delta smelt with relation to turbidity plumes is proposed as part of this Project. This study involves the temporary installation of a trawl net at two locations in the Delta (near Decker Island in the Sacramento River and near Jersey Point in the San Joaquin River) and the monitoring and analysis of time-series data regarding the location and density of pre-spawning, adult delta smelt captured in the net. Hydrodynamic conditions will be monitored while fish sampling is conducted over a complete tidal cycle (about 12 hours) at two locations. Tidal currents will bring the fish (and turbidity) to these two fixed locations. Because tidal excursions in the Delta can be quite long – on the order of 8 miles in the western Delta – such a sampling design will allow a total of 16 miles of river channel to be sampled at each location over each tidal cycle. Trawling is proposed to begin immediately after it rains during the first “large” storm of the year. Sampling will take place on alternate days for about one week, or until the fish noticeably shift their distribution up the Sacramento or San Joaquin rivers.

Hydrodynamic monitoring will collect time series of river discharge and velocity (either depth or laterally averaged), as well as electrical conductivity, temperature, salinity, and turbidity of the water at each sampling location. Fish sampling will use either the Kodiak trawl system or the mid-water trawl net. Fish sampling will occur on an hourly schedule, and all captured delta smelt will be measured and preserved for analysis of growth (i.e., otoliths) and overall health and condition (i.e., histology) following standard protocols enlisted for the Pelagic Organism Decline (POD) studies (Bennett, W., J. Hobbs, and S. Teh. 2008). Additional details regarding this study are included as Attachment C to the Science & Monitoring Plan (Appendix C).

2.5.4 Fixed Site Monitoring to Understand Hydrodynamic Transport Processes

Another special study is planned to examine Project effects on a hydrodynamic process for larval and juvenile delta smelt transport. The operations scenario for larval and juvenile protection involves opening Old River gate on ebb-tide and closing it on flood creates net circulation downstream on Old River and upstream on Middle River with the goal of increasing mixing between Franks Tract and western San Joaquin River. The dispersive mixing hypothesis will be tested through a specific enhancement of water quality and hydrodynamics monitoring that will measure changes in the salt flux (and perhaps *chlorophyll a* (Cl-a) flux) in False River. For example, chemical fingerprinting of water can be used to differentiate San Joaquin River and Sacramento River waters within False River and the western Delta.

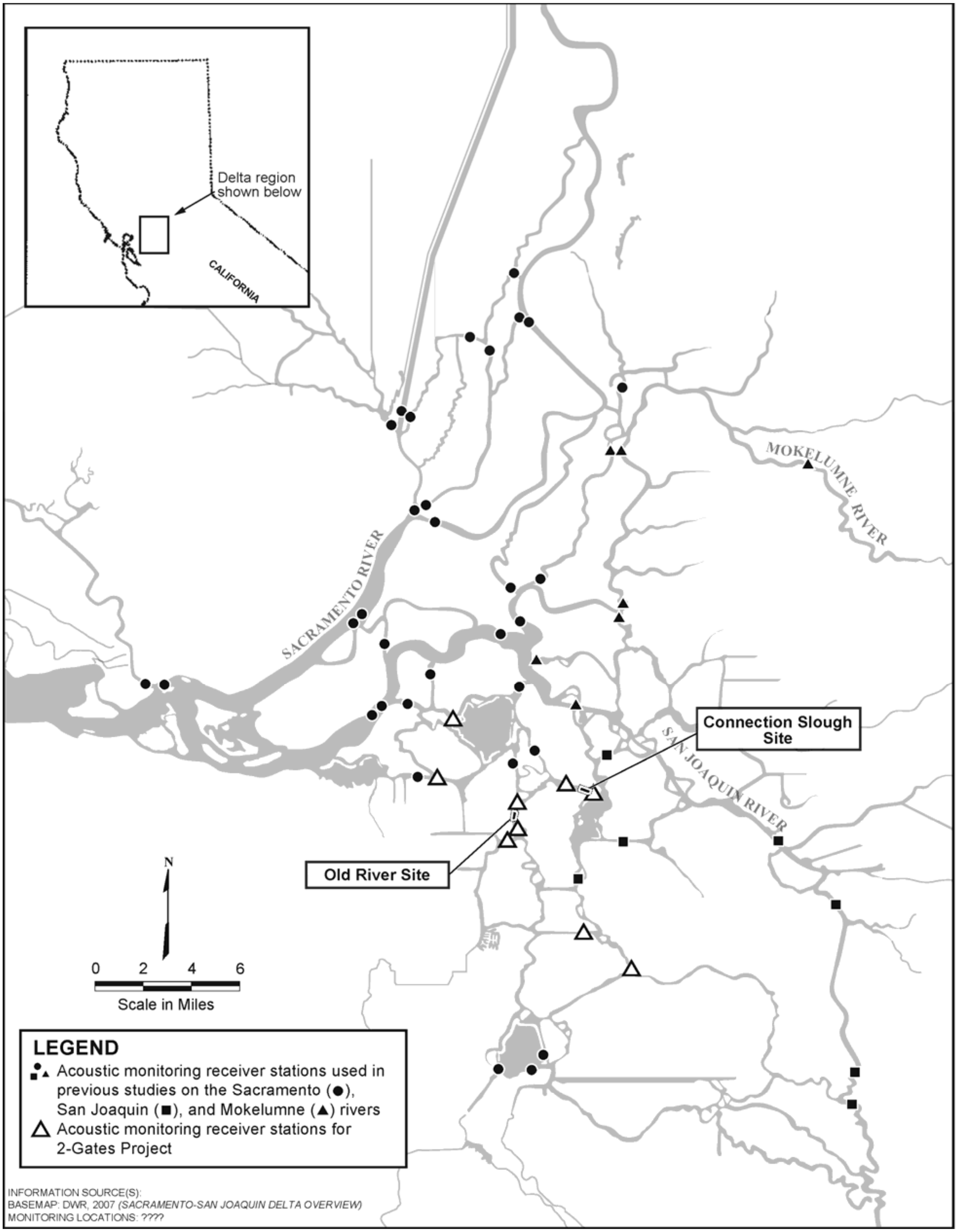


Figure 2-14 **Integration of the 2-Gates Monitoring with Other Potential Salmon Outmigration Studies in the Delta Using Acoustic Tagging Methods (Sacramento, Mokelumne, and San Joaquin River (VAMP)**

If 2-Gates Project operations do increase dispersive exchange of water (and hopefully larval and juvenile delta smelt) from the central and southern Delta into the western delta and salinities are elevated in the San Joaquin, then San Joaquin River salt could be used as a conservative tracer. If the "dispersive mixing mechanism" is working as planned, then an increase in dispersive flux in False River should be detected, which would be directed from Franks Tract into the western San Joaquin Delta – a direct measure of the effectiveness of 2-Gates Project operations in creating this transport mechanism. Moreover, if 2-Gates Project operations facilitate westward transport of organic carbon (e.g. phytoplankton) originating in the upper San Joaquin River and southern Delta, then an increase in Chl-a flux should be observed through False River (presuming it is not completely grazed down by the benthos). These are but a handful of examples of how fluxes will be used in this project to inform real time operations and evaluate performance.

Further details on the study design and flux computations are provided in Attachment C of Appendix C. As described above (Section 2.5.1), additional sensors for salt and/or Chl-a will be added to existing water quality monitoring stations to provide data for calculating fluxes.

2.5.5 Fish Passage and Predation

Sonic Cameras (DIDSON Cameras)

Sonic cameras (DIDSON cameras) will be used to detect large fish or fish populations in the vicinity of the gates and in other similar habitats in Old River and Connection Slough. Cameras will be fixed or boat mounted and pre-set to detect target species in designated depth ranges and sizes. The boat mounted DIDSON camera will be operated at established monitoring points used to repetitively monitor conditions on both sides of each gate (Figures 2-15 and 2-16). Monitoring sites will include near-gate sites and sites in other locations in the channel without a gate structure. The boat mounted DIDSON camera will also be used to investigate changes in fish distribution during times when the gate is opened or closed. DIDSON cameras will be used to monitor:

- Predator fish in the vicinity of the gate structures compared to predators in other similar habitats.
- Whether sturgeon or other migratory fish are detected passing the gate when open or closed, or if they persist in the gate area when the gates are closed.
- Possible behavior of fish near the gate structures.

Predator Removal

If predators become a problem at the gate sites they may need to be removed. Detailed protocols for assessing predator populations and potential predation risks need to be worked out with the permitting agencies based on the factors still in development. These protocols would be fully developed with a Predation Risk Assessment Team comprised of biologists from the USFWS, NMFS, DFG, DWR, and BOR. The protocols consider predator populations as to species and size near the gates, the time of year, species and life stages potentially at risk from predation and the duration of that risk. These risks would then be placed into context with other factors affecting these populations in the Delta.

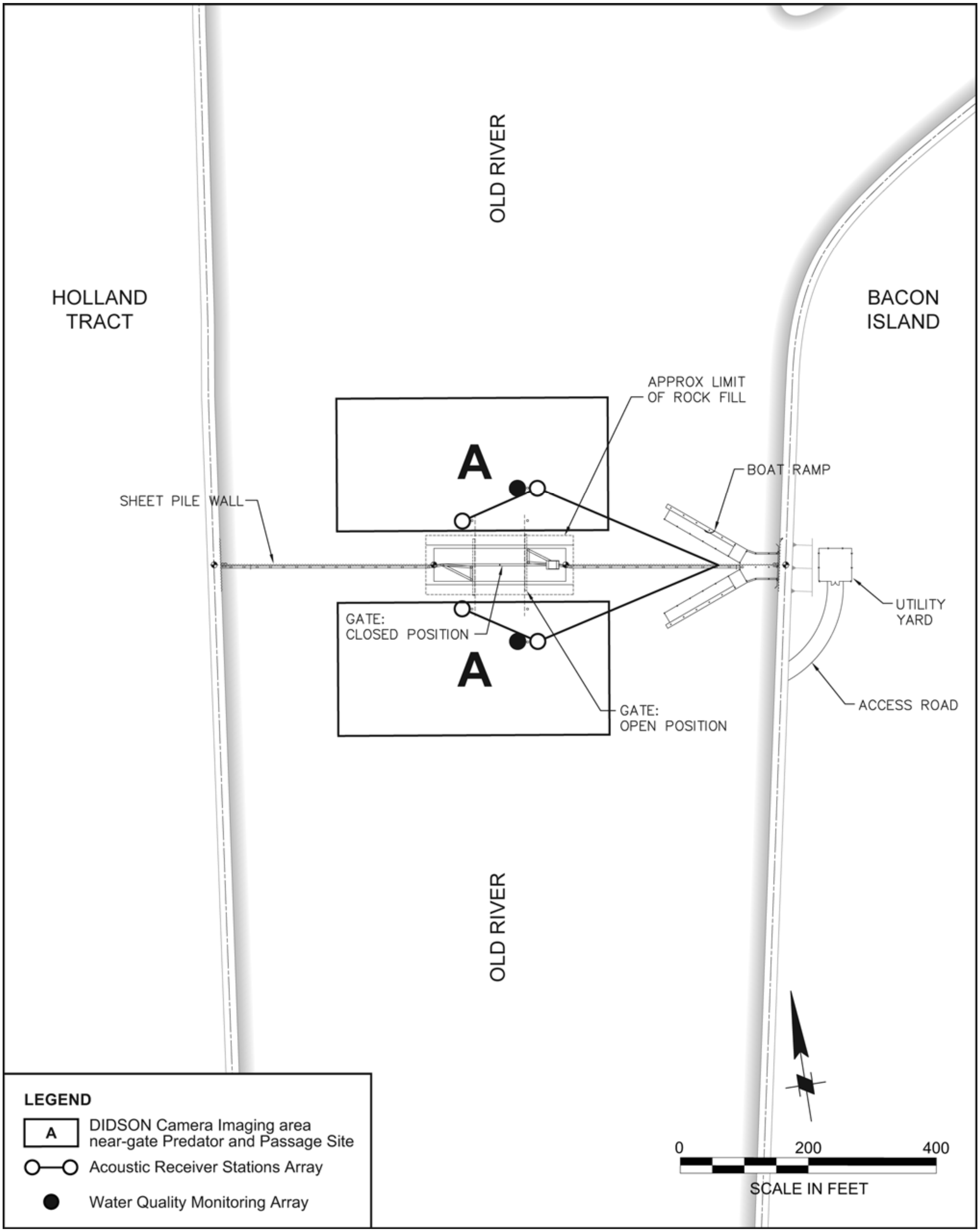


Figure 2-15 **Old River Gate Area Showing Location of Continuously Recording Hydrophone Array, Monitoring Areas for Boat-Based DIDSON Imaging and Electrofishing Sites**

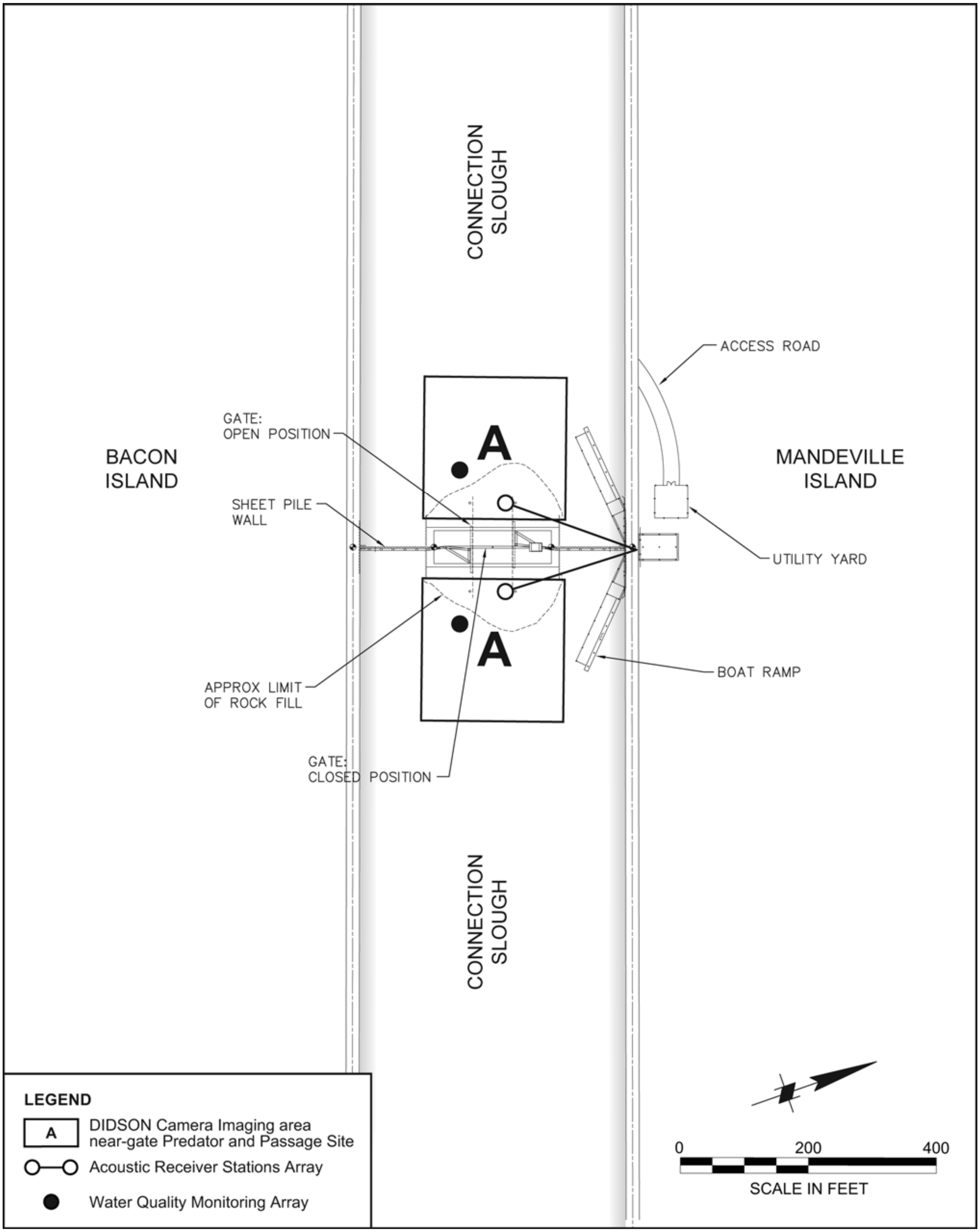


Figure 2-16 Connection Slough Gate Area Showing Location of Continuously Recording Hydrophone Stations, Areas for Boat-Based DIDSON Imaging and Electrofishing Sites

2.5.6 Data Collection and Distribution

All data will be collected in accordance with established, standardized sampling protocols. Existing sampling programs will utilize existing written sampling protocols when conducting sampling at new locations or times. New written protocols will be developed for new monitoring programs, such as DIDSON camera monitoring. All written protocols will be refined for project needs and provided to Reclamation and SLDMWA for review and comment. All data will be collected to the highest standard of accuracy.

All data will be carefully entered and stored in specifically designed Access databases. These databases will include both existing agency databases and a new 2-Gates monitoring team database. Data will be pulled from agency databases and the 2-Gates monitoring team database by the 2-Gates analysis and synthesis team (Figure 2-17).

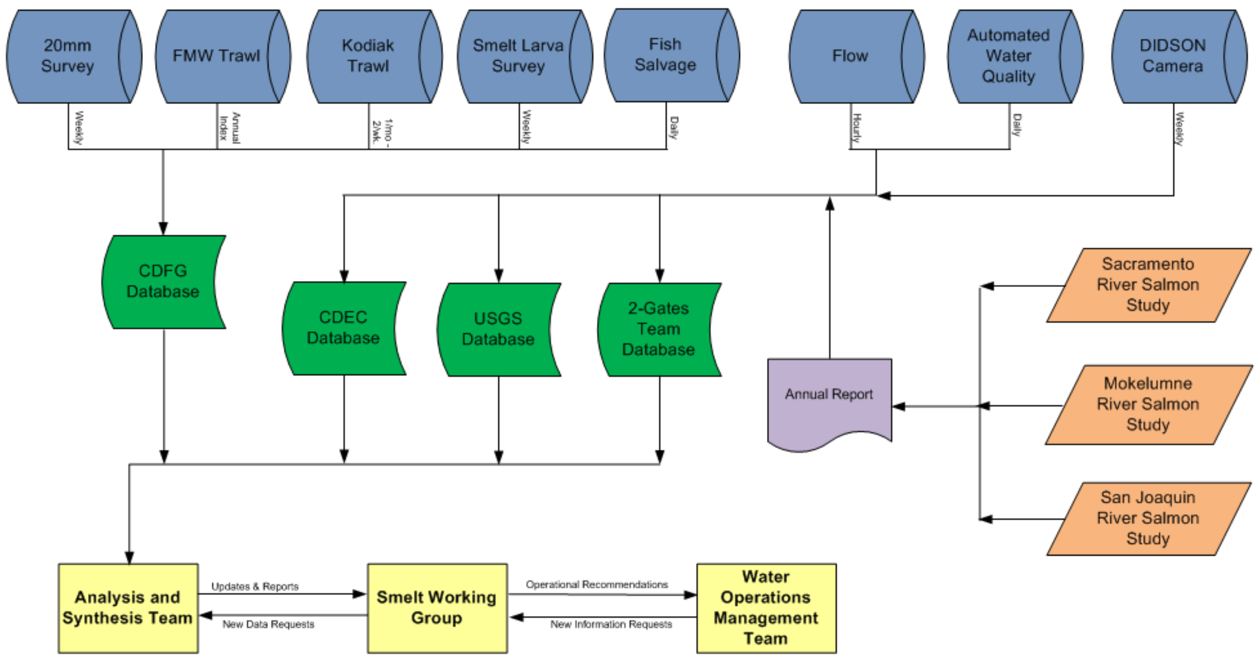


Figure 2-17 Proposed Information Management Structure for the 2-Gates Monitoring Program

2.5.6.1 Quality Assurance/Quality Control

All data pulled from agency and project team databases will be subject to 2-Gates monitoring team QA/QC procedures. These procedures will include written protocols, staff training, data checks, fish identification verification, and peer-review procedures. Written protocols will be developed for all sampling and monitoring, and provided during staff trainings to ensure all data are collected according to established standards. Field data will be checked at collection. All monitoring data will be tagged as preliminary, provisional, or final prior to use in updates and reports by the analysis and synthesis team.

2.5.6.2 Analyses Framework

Monitoring results will be utilized to drive an adaptive management feedback loop in which the Project team and agency representatives will analyze the data that is collected, communicate the results, and make decisions to adapt operations and monitoring. Key elements that will be considered include:

- Determining the effectiveness of OCAP and 2-Gates triggers for gate operations including the 12 NTU turbidity threshold and Old River/Middle River reverse flow ratios.
- Defining desired water quality conditions and fish abundance indices in order to gauge project effectiveness over short and long time scales.
- Defining thresholds for considering and implementing operational changes.
- Defining the types of operational changes that could feasibly be implemented.
- Obtaining baseline data from existing or additional monitoring programs.
- Refining existing water quality and fish behavior models to better define the relationship between hydrodynamics, turbidity, and fish response based on new data.

Statistical analyses may be performed with several programs (i.e., S+, R, Origin, PRIMER, JMP and Excel). Daily and weekly memoranda, as well as monthly reports, will be written by the analysis and synthesis team and provided to the SWG and the DOSS. The SWG and DOSS may make additional data requests to the analysis and synthesis team. After analyzing the memoranda and reports, the SWG and DOSS will provide operational recommendations to the WOMT. The WOMT will make major decisions on operational changes related to the Project. The WOMT may request additional information and analysis from the SWG or the Project analysis and synthesis team (Figure 2-17).

2.5.6.3 Products and Disposition of Results

Deliverables will include monthly progress reports with invoices, brief daily and weekly memoranda, e-mail status updates, alerts and meetings on potential problems or surprises affecting operations or deliveries, presentations at science conferences, and annual drafts and final reports. All deliverables and results from the 2-Gates monitoring effort will be provided to the WOMT and the SWG for incorporation into the decision making process for operation of the SWP and CVP facilities and to the entity responsible for operating the gates.

2.5.6.4 Feedback to Project Team

The SWG and the WOMT will provide the Project analysis and synthesis team with feedback in a variety of forms. The SWG and WOMT may need additional data and analysis, an answer to a specific question, or clarification on a statement made in an analysis document. Furthermore, the SWG and WOMT will make annual assessments of whether Project monitoring protocols are meeting the needs of Project decision makers. An open line of communication between the SWG, DOSS, and the WOMT, and the Project analysis and synthesis team will be essential to the success of the monitoring program.

2.6 2-GATES OPERATIONS IN CONJUNCTION WITH OCAP BO FLOW MANAGEMENT

2-Gates operations will be conducted in conjunction and coordination with the OCAP BO Old and Middle River RPAs. Flow, salinity, turbidity, and particle forecasting simulations will be performed to forecast timing of the Old River and Connection Slough gate operations consistent with the RPAs. OMR flows restrictions will be achieved primarily through export curtailments.

The RPAs most relevant to the Project include (Figure 2-11):

- FWS OCAP BO RPA 1 Action 1: Adult Migration and Entrainment (First Flush)
- FWS OCAP BO RPA 1 Action 2: Adult Migration And Entrainment

- FWS OCAP BO RPA 2 Action 3: Entrainment Protection Of Larval Smelt
- NMFS OCAP BO RPA IV Action 2.1 San Joaquin River Inflow to Export Ratio
- NMFS OCAP BO RPA IV Action 2.3 Reduced exports to limit negative flows in OMR depending on presence of salmonids

As described in the OCAP BOs, Reclamation and DWR work closely with the Service, NMFS, and DFG to coordinate the operation of the CVP and SWP with fishery needs. This coordination is facilitated through several forums in a cooperative management process that allows for modifying operations based on real-time data that includes current fish surveys, flow and temperature information, and salvage or loss at the project facilities.

The Project will coordinate with the existing decision-making process, as shown in Figure 2-18. Key teams and technical groups participating in the decision-making process include technical groups (SWG and DOSS) and management (WOMT). Under the FWS OCAP BO, the Smelt Working Group (SWG) meets to consider fish distribution and relative abundance in light of Delta conditions and makes recommendations to USFWS. The Service then brings the proposed action (which may be modified from what the SWG has recommended) to Water Operations Management Team (WOMT). Under the NMFS OCAP BO, the Delta Operations for Salmon and Sturgeon Technical Working Group (DOSS) provides recommendations to NMFS, which then brings proposed action to WOMT. The WOMT can either adopt the USFWS's determination or can suggest an alternative action. The USFWS then has the ultimate decision. The 2-Gates Project operations will fit into this adaptive process, providing a new management tool (gate operations) and additional data for the regulatory agencies' decisions.

The FWS identified a suite of triggers and responses or "tools for change to guide decision-making (Attachment A of USFWS 2008). The Project will expand the options for response available to the SWG, WOMT, DOSS and the agencies. We provide a new functional trigger for a key process (turbidity, which is hypothesized to cue adult spawning migration) and another tool for management (operable gates to allow manipulations of hydrodynamics and turbidity distribution).

2.7 PROJECT MAINTENANCE

Project facilities will require limited maintenance, which will include:

- Infrequent fueling and lubrication of emergency generators,
- Repair of coatings (e.g., painting) necessary to maintain equipment function, and
- Equipment repair essential to maintain Project function.

On-site maintenance will occur on a regular basis through qualified contracting services retained as part of the operational protocols of the Project. Annual maintenance activities will be scheduled to occur during the summer-fall non-operations period.

2.8 FACILITIES REMOVAL

At the end of the five-year demonstration period, the barges and all associated facilities will be deballasted and removed from the Project sites. Rock fill will be removed down to the initial channel bed elevation and transported from the area on barges. If it appears that there is a future use for the rock fill at or near the Project sites in the foreseeable future, it could be trucked to the off-site storage/disposal area on Holland Tract (Figure 2-3) until needed. All other structures and materials, including the boat launching structures, will be removed. The removal process will take approximately four weeks.

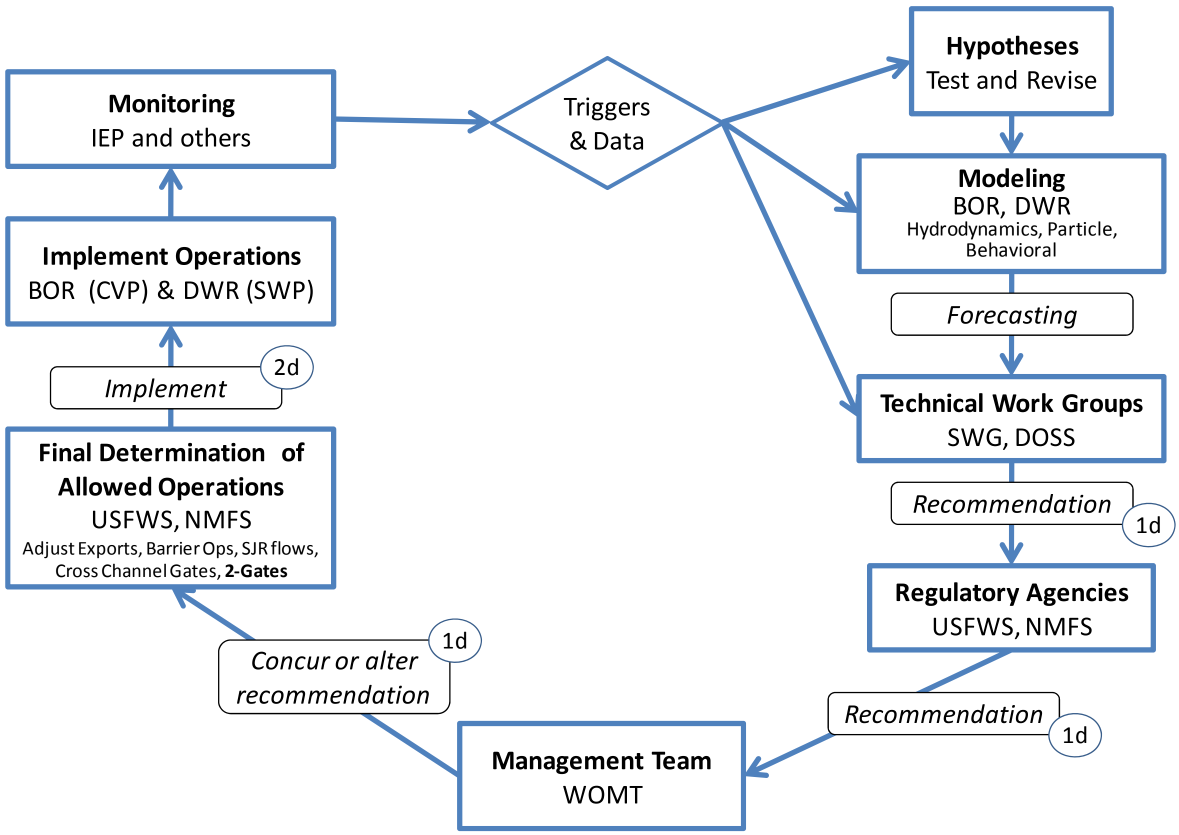


Figure 2-18 Framework for Decision Making, Operations and Monitoring

2.9 SITE RESTORATION

Disturbed areas will be restored after initial construction and after Project structures are removed, including construction laydown areas, land-based utility yards, and pile-supported boat ramps. Restoration activities will be facilitated by siting access routes, laydown areas, and structures to avoid sensitive areas (e.g., wetlands) and by limiting the duration of the use of land-based areas. The construction laydown areas will be used only during the associated land-based construction/removal periods. The affected areas will be restored to meet local land use and resource agency requirements as soon as they are no longer needed. The pile-supported boat ramps will be removed as soon as they are no longer necessary, and the area below these decks also will be restored to meet local land use and resource agency permit conditions.

A restoration plan will be developed, as required by applicable regulatory agencies, and will be completed prior to the onset of construction. The restoration plan will identify areas that will be restored and restoration methods. Seed mixes, schedules, success criteria, and success monitoring for restoration of wetlands, streams, and drainages will be identified. The restoration plan will be included in the contract specifications.

2.10 PROTECTIVE MEASURES FOR LISTED SPECIES

This section describes the features of the Project that have been incorporated into the design and construction approaches to avoid and protect listed species and habitats.

2.10.1 Avoidance of Sensitive Resources

Fisheries and wildlife biologists and archaeologists have been working closely with the Project engineers to design the Project in the least environmentally damaging manner. Sensitive biological resources have been identified and avoided to the extent feasible. Avoidance and minimization measures also will be used in the field during construction as a result of preconstruction surveys or at the direction of permitting documents or additional consultations. If required, the construction will be coordinated through USFWS or NMFS approved specialist familiar with the species involved. The locations of all sensitive biological (and cultural) resources and the methods to avoid them will be included in the construction drawings.

2.10.2 Minimization of Impacts on Sensitive Aquatic Species

Project construction and operations have been designed to reduce or eliminate potential adverse effects on sensitive aquatic species. Further, the Project contains augmentations to existing monitoring programs to inform day-to-day operations of project facilities and further reduce negative effects to resident and anadromous species listed species. Negative effects on listed aquatic species have been identified in this BA and measures to minimize or avoid those effects are included. The Project is subject to the permitting requirements of the USFWS, NMFS, and DFG, and these agencies may impose additional measures beyond those identified in this BA. The lead agencies will comply with the RPAs or other actions required by these regulatory agencies.

2.10.3 Erosion, Sediment Control, and Spill Prevention Measures

Installation of the gates may result in sediment being disrupted to create increased turbidity within the areas where dredging will occur. Areas along the levees that are cleared prior to construction or where materials will be stored may disturb soil and vegetation and expose sites to possible erosion. Best Management Practices (BMPs) will be undertaken in accordance with the California Code of Regulations. Spill prevention measures detailed in the Storm Water Pollution Prevention Plan (SWPPP), as required under the National Pollutant Discharge Elimination System (NPDES) permit mandated by the Central Valley Regional Water Quality Control Board (CVRQCB), will be developed to prevent or minimize soil erosion and protect against storm water runoff. In addition, the contractor will be required to make special provisions to prevent contamination, related to fuel or oil spills from construction vehicles, and to designate specific areas for vehicle fueling, oil changing, and washout of concrete trucks with controls to eliminate runoff.

The following standard erosion and sediment control measures and practices will be used during and after construction to ensure that impacts from soil erosion and sedimentation are less than significant:

- 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

These measures are routinely implemented in the construction industry and have been proven successful for similar projects.

The following measures have been incorporated into the Project design and operations plan in order to minimize impacts from in-channel construction on the water quality for aquatic species:

- The dikes on either side of the barge that supports the operable gates will be constructed of sheet piles instead of rock. This will minimize impacts by:
  - Minimizing the footprint of the Project
  - Minimizing the amount of dredging that is necessary along the bottom of Connection Slough and Old River, thus reducing the amount of soft bottom habitat loss, turbidity caused by dredging, dredged material, and the dredge disposal area required.
  - Minimizing the amount of turbidity resulting from in-water construction activities by reducing the footprint area of dikes connecting the gate structure to adjoining levees and reducing in-channel excavation only to that directly under the gate structure.
  - Reducing predation because sheet piles provide less habitat structure for predator fish in the vicinity of the gates.

2.10.4 Turbidity Criteria

For the construction phase (late summer to early winter 2009) and the removal in 2014, the following turbidity control performance measures will be implemented, subject to the approval of the applicable resource agencies (USFWS, NMFS, and DFG). The primary turbidity control method will be the cessation of activities (e.g., dredging) contributing to the increase in local turbidity.

- The Project contractor will minimize turbidity increases in surface waters to the extent practicable by conducting all in-water activities in a manner that minimizes turbidity through the implementation of approved BMPs and complying with the requirements of the RWQCB Water Quality Certification. The water quality criteria for turbidity in the Delta are as follows:
  - Where natural turbidity is between 0 and 5 NTUs, increases will not exceed 1 NTU.
  - Where natural turbidity is between 5 and 50 NTUs, increases will not exceed 20 percent. Where natural turbidity is between 50 and 100 NTUs, increase will not exceed 10 NTU.
  - Where natural turbidity is greater than 100 NTUs, increases will not exceed 10 percent. These limits will be eased during in-water working periods to allow a turbidity increase of 15 NTU over background turbidity as measured in surface waters 300 feet downstream from the working area.

In determining compliance with above criteria, appropriate averaging periods may be applied, provided that beneficial uses will be protected. Turbidity will be monitored by taking grab samples for analysis of NTU levels twice per day during the work period.

2.11 ENVIRONMENTAL COMMITMENTS / MINIMIZATION AND AVOIDANCE MEASURES INCORPORATED AS PART OF THE PROJECT

The following mitigation measures have been identified as part of the environmental impact analysis conducted in the associated MND/EA Mitigated Negative Declaration/ Environmental Assessment (MND/EA) and will be implemented as part of the Project. All of the mitigation measures noted in the MND/EA have been identified below to fully disclose all details of the Project, but many are not relevant to federally listed species. At both sites land adjacent to the levees is lower than the water surface in the channels; therefore, disturbance of these areas are not likely to affect fishery resource through the normal process of land erosion. Seasonal wetland affects are evaluated in the Terrestrial portion of this BA.

By implementing Mitigation Measure BIO-1, the Project Proponent would reduce the potential for impacts on giant garter snake to a less-than-significant level.

Mitigation Measure BIO-1: Avoidance, minimization, and mitigation measures for GGS include the conduct of preconstruction surveys, biological monitoring during construction and the implementation of the following protection measures by the Project Proponent:

Mitigation Measures (a) through (j) will be applied regardless of the timing of construction activities:

a. Movement of heavy equipment will be confined to existing roadways and the construction work areas defined on project plans and in Section Figure 5.3 (in Section 5) to minimize habitat disturbance

b. Clearing will be confined to the minimum area necessary to facilitate construction activities. GGS habitat adjacent to the project area will be flagged and designated as Environmentally Sensitive Areas and will be avoided by all construction personnel.

c. Construction personnel will receive Service-approved worker environmental awareness training from a USFWS-approved biologist. The training shall include a description of the GGS, including natural history and habitat, a review of the state and federal listing of the species, the general protection measures to be implemented to protect the species, and a delineation of the limits of the work areas. Employees also shall be required to sign documents stating that they understand that the taking of listed species and destruction or damage of their habitat could be a violation of state and federal law.

d. 24-hours prior to construction activities, the project area will be surveyed for giant garter snakes. Surveys of the project area will be repeated if a lapse in construction activity of two weeks or greater occurs.

e. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. Any sightings and any incidental take will be reported to the Service and CDFG immediately.

f. At the end of the 2-Gates Project, terrestrial and wetland habitat disturbed during construction and removal of the gates shall be restored to pre-Project conditions. Restoration work may include replacing rip-rap removed during construction and replanting or seeding with plant species that were removed during construction and removal activities.

g. If the species is observed at the construction site at any time during construction or operations, work shall cease immediately within 200 feet of the area until the snake leaves the work area under its own volition and is out of harm's way. USFWS and DFG shall be contacted immediately.

h. A monitoring report of all activities associated with surveys and mitigation for this species shall be submitted to DFG and USFWS no later than one month after land-based construction is completed.

i. Not less than 48 hours prior to the start of any construction activities, including the removal of the structures, the USFWS-approved biologist shall monitor the installation of exclusionary fencing around the terrestrial portion of the area subject to disturbance. The fencing shall contain one-way exits so snakes within the fenced area will be able to escape but not reenter. Habitat features suitable for GGS within the perimeter of the fence shall be removed under the direct supervision of the USFWS-approved biologist, and any snake detected shall be allowed to leave on its own accord. The USFWS and DFG shall be notified within 24 hours of any GGS (living or dead) observed during Project construction.

j. In order to minimize the effects of loss and disturbance of habitat on giant garter snakes, habitat will be replaced based on the acreage and on the duration of disturbance. Compensation for the loss of upland habitat shall be achieved through the restoration of upland refugia, the acquisition of suitable habitat offsite, and/or the purchase of conservation credits. The acreage of restored and preserved habitat will be determined through consultation with the DFG and USFWS, taking into account the time of year when construction activities occur and the quality of on-site habitat and off-site compensatory habitat. Table 2-7 below summarizes GGS habitat conservation measures.

In addition to Mitigation measures (a) through (j), Mitigation measure (k) through (l) will be applied for land-based construction during the active season for GGS:

k. Construction related activities shall require daily monitoring during the active season for GGS. All land-based disturbance and channel/water work shall be monitored by a USFWS-approved biologist, and a visual survey shall be conducted every morning prior to equipment moving to avoid crushing animals. When possible, habitat features useful to GGS shall be avoided or removal shall be closely monitored by the USFWS-approved biologist. Habitat features include rip-rap, rodent burrows, debris piles, and dense vegetation.

l. There is a potential that trapping surveys may be effective in some areas of the Project site, and may be implemented upon approval of this method by DFG and the USFWS.

In addition to Mitigation measures (a) through (j), Mitigation measures (m) through (n) will be applied if land-based construction occurs during the dormant season for GGS:

m. A USFWS and DFG-approved captive salvage facility shall be identified prior to the start of ground disturbance. If during construction a live GGS is detected that is unable to leave the Project area safely on it's own accord, the permitted biologist shall immediately contact the USFWS and DFG to determine whether or not to capture and protect the snake, taking in to consideration the weather, time of year, condition of the snake and where it was caught. If the USFWS and DFG direct the permitted biologist to capture and protect the snake, it shall be moved to the approved facility until it can be released during the active season (May 1 to September 30) to suitable habitat outside the area of disturbance. The USFWS and DFG shall be notified within 24 hours of any GGS observed during Project construction.

n. Twenty-four hours prior to the start of construction activities, a qualified biologist in possession of a recovery permit for GGS shall conduct a preconstruction survey of the site. The permitted biologist shall monitor all initial site disturbances, including vegetation clearing, the removal of piles of debris, construction materials, agricultural equipment, riprap along the levees, and other materials that may provide suitable upland refugia for GGS. The biologist shall monitor all initial site disturbances in areas where small mammal burrows or subsurface features that provide hibernation habitat are present. The biologist shall have the authority to direct the excavation of suitable hibernation habitat in a manner that will maximize the potential for live salvage and minimize the risk that snakes will be crushed or wounded.

Table 2-7 Summary of Giant Garter Snake Conservation Measures

	Impacts: Duration / Time of Year	Impacts: Acres	Conservation Measure: Compensation
Level 1	1 season	Less than 20 and temporary	Restoration
Level 2	2 seasons	Less than 20 and temporary	Restoration plus 1:1 replacement
Level 3	More than 2 seasons and temporary	Less than 20 and temporary	3:1 Replacement (or restoration plus 2:1 replacement)
	Permanent loss	Less than 3 acres total giant garter snake habitat And Less than 1 acre aquatic habitat; Or Less than 218 linear feet bank habitat	3:1 Replacement
Level 4	Construction during dormant season	Less than 20 and temporary	Restoration and up to 6:1 replacement

Mitigation Measure BIO-2: The Project Proponent will implement the following measures to minimize potential impacts on WPT:

a. Not more than 48 hours prior to the start of site disturbance, a qualified biologist familiar with WPT behavior shall conduct focused visual surveys for western pond turtles and any nesting activity (i.e., nests, egg shell fragments) on the Project site. Preconstruction surveys shall include available nesting habitats within 1,319 feet of suitable aquatic habitats that will be impacted during construction or removal of the Project. After the preconstruction surveys, silt fencing, buried not less than 6 inches at the base, will be installed around the perimeter of the laydown area, and the removal of vegetation within the laydown areas that is required for Project construction shall be conducted under the direct supervision of the qualified biologist.

b. If juvenile or adult WPT are found aestivating or hibernating on the Project site, construction work will cease within 50 feet of the area and the biologist will move the individuals out of the construction area to suitable habitat prior to resuming construction work. If a nest is found in the construction area, DFG will be notified immediately to determine appropriate measures to protect or relocate the nest. Surveys must be conducted every year in which land-based construction activities occur.

c. A letter report documenting survey methods and findings shall be submitted to DFG following the completion of the preconstruction survey.

d. Before land-based construction, a worker environmental training awareness program shall be conducted by a qualified biologist. The training shall include instruction regarding species identification, natural history, aquatic and upland nesting habitat, the general conservation measures to be implemented to protect the species, and a delineation of the limits of work.

Mitigation Measure BIO-3: Conduct surveys for western burrowing owl and, avoidance or mitigation for owls, if present. The Project proponent will implement the following measures to minimize potential impacts on burrowing owls:

The California Burrowing Owl Consortium's (CBOC) Burrowing Owl Survey Protocol and Mitigation Guidelines (1993) and the DFG Staff Report on Burrowing Owl Mitigation (1995) state that mitigation actions should be carried out from September 1 to January 31. These documents explain that reproductive timing may vary with latitude and climatic conditions, therefore the Staff Report states that the time frame to carry out mitigation activities should be adjusted accordingly.

a. Surveys consistent with the California Burrowing Owl Survey Protocol and Mitigation Guidelines (CBOC 1993) shall be conducted in all areas where construction-related site disturbance may occur and within a 500-foot buffer of land-based disturbance. A survey to determine if suitable burrows (larger than 3.5 inches diameter) are present in all areas of ground disturbance shall be conducted. If no burrows suitable for burrowing owls are present in areas of ground disturbance then no other activities are necessary to avoid effects to individuals.

b. If suitable burrows are present in the Project area then all areas of ground disturbance (including access roads) shall be surveyed for occupancy by burrowing owls within 30 days of initial ground disturbance. The California Burrowing Owl Survey Protocol and Mitigation Guidelines (CBOC 1993) calls for up to four surveys on four separate days to determine burrowing owl presence or absence.

c. No disturbance shall occur within 250 feet of occupied burrows during the breeding season (February 1 through August 31). If burrowing owls are present within 160 feet of construction during the non-breeding season (September 1 through January 31), a site-specific impact avoidance plan shall be prepared by a burrowing owl biologist[4] and submitted to DFG for approval. The Plan shall describe passive relocation procedures and maintenance of one-way doors during site disturbance, if applicable, and habitat restoration after the Project is completed. Passive relocation procedures shall include the installation of one-way doors in burrow entrances by a qualified biologist. One-way doors shall be left in place not less than 48 hours to ensure that owls have left the burrow prior to excavation of the burrow by the qualified biologist.

d. If construction activities result in the loss of occupied habitat, mitigation consistent with the DFG Staff Report on Burrowing Owl Mitigation Guidelines (1995) shall be provided by permanently protecting not less than 6.5 acres of suitable habitat per pair or unpaired resident owl at a location acceptable to DFG. Long-term management and monitoring of protected habitat acceptable to DFG shall be provided.

e. Before land-based site disturbance, a worker environmental training awareness program shall be conducted by a qualified biologist. The training shall include instruction regarding species identification, natural history, habitat, and protection needs. If the species is observed at the construction site at any time during construction, construction work shall cease within 160 feet of the area until the animal can be moved to a safe location consistent with DFG regulations.

f. A monitoring report of all activities associated with surveys and mitigation for this species shall be submitted to DFG within one month after construction is completed. If owls are observed in the study area, monitoring reports shall be submitted to DFG before any action is taken. CNDDB reports shall be submitted within one month of each observation with a copy to the local DFG biologist.

Project 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. By implementing Mitigation Measure BIO-4, the Project Proponent would reduce the potential for construction-related impacts on Swainson’s hawk to a less-than-significant level.

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[4] A burrowing owl biologist is a wildlife biologist who can demonstrate first-hand knowledge of burrowing owl reproductive behavior and has demonstrable field experience monitoring burrowing owl reproductive behavior during all stages of the nesting cycle (i.e., courtship, egg-laying, incubation, nestling, and emergent juvenile and dispersal stages).

Mitigation Measure BIO-4: Conduct preconstruction surveys for Swainson's hawk prior to construction activities and implement avoidance or mitigation activities for Swainson's hawk, if present:

a. Surveys consistent with the Swainson's Hawk Technical Advisory Committee's Recommended Survey Methodology (May 31, 2000) shall be conducted by a wildlife biologist with first-hand knowledge of Swainson's hawk reproductive behavior within 0.25 mile of site disturbance activities such as gate construction or removal if such activities are scheduled to occur between March 15 and September 15.

b. If occupied Swainson's hawk nests are detected within 0.25 mile of site disturbance activities, site disturbance shall be postponed until a qualified nest monitor determines that the young birds have fledged and are no longer reliant on the nest site.

   If site disturbance is proposed within 0.25 mile of an active nest before the young birds have fledged, the Project Proponent shall consult with DFG to determine the appropriate course of action, which may include 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.). Additionally, acquisition of a 2081 Permit from DFG may be required, and the Project Proponent would be required to adhere to any other conditions imposed under the permit.

Project operations would not result in impacts to black rail. 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 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. By implementing Mitigation Measure BIO-5, the Project Proponent would reduce the potential for construction-related impacts on black rail to a less-than-significant level.

Mitigation Measure BIO-5: Conduct preconstruction surveys for black rail prior to gate removal activities and avoidance or mitigation activities, if present:

Surveys consistent with the Point Reyes Bird Observatory Black Rail Survey Protocol (PRBO undated, Spautz, H, Nur, N and D Stralberg. 2005) shall be conducted between March 15 and May 31 in the year when gate removal is scheduled. If black rail are detected within 0.25 mile of the gates, measures to avoid impacts to nesting behavior shall be developed in consultation with DFG and implemented. Such measures may include a delay in gate removal until young birds are foraging independently and nest monitoring by a qualified biologist with stop-work authority in the event that gate removal operations posed a risk to nest habitat. Additionally, acquisition of a 2081 Permit from DFG may be required, and the Project Proponent would be required to adhere to any other conditions imposed under the permit.

Project operations would not result in impacts to protected bird species. 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 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. By implementing Mitigation Measure BIO-6, the Project Proponent would reduce the potential for construction-related impacts on nesting birds to a less-than-significant level.

Mitigation Measure BIO-6: Conduct preconstruction surveys for nesting birds prior to construction activities and implement avoidance or mitigation activities for nesting birds, if present:

a. If site disturbance commences between February 15 and August 15, a pre-construction survey for nesting birds shall be conducted by a qualified wildlife biologist. If nests of either migratory birds or birds of prey are detected on or adjacent to the site, a no-disturbance buffer in which no new site disturbance is permitted shall be fenced with orange construction fencing or equivalent, and the buffer shall be observed until August 15, or the qualified biologist determines that the young are foraging independently or the nest has failed. The size of the no-disturbance buffer shall be determined by a qualified wildlife biologist in consultation with DFG and the USFWS, and shall take in to account local site features and pre-existing sources of potential disturbance. If more than 15 days elapses between the survey and site disturbance, the survey shall be repeated.

Individual special-status plants present within the development envelope of the Project could be negatively impacted by work conducted within the Project area. By implementing Mitigation Measure BIO-7, the Project Proponent would reduce the potential for construction-related impacts on special-status plants to a less-than-significant level.

Mitigation Measure BIO-7: Conduct preconstruction surveys for rare plants, and, avoidance or mitigation for rare plants, if present:

a. Rare plant surveys, timed to coincide with the flowering period of target species (spring and summer) shall be conducted to determine if any special-status plant species are present within the study area. Spring and summer surveys have already been conducted on a portion of the Holland Tract study area and on all of the Bacon Island study area.

b. If rare plants are present within the development area of the Project, the feasibility of avoidance shall be evaluated. Avoidance would include the installation of orange construction fencing around the plants prior to site disturbance and ensuring that rare plants are not disturbed during construction. The spring and summer-blooming rare plants observed within the study area to date would be afforded protection by this measure.

c. If surveys timed to coincide with the flowering period for target species cannot be performed for any reason, including a lack of access to the site, presence shall be assumed. Prior to construction, a thorough search for plants sharing the vegetative characteristics of target species shall be made and if present, those plants shall be assumed to be the sensitive species. Individual plants found shall be subject to the measures described in (d), below.

If avoidance is not feasible, a mitigation plan, approved by DFG, shall be developed and implemented, including, but not restricted to the following measures: (1) the number and area of rare plants affected by the Project shall be measured and documented; (2) affected plant(s) shall be transplanted to a suitable nearby area or seed shall be collected and sown on a nearby area possessing similar habitat characteristics (one possible site is the Wildlands, Inc. marsh restoration area located on Holland Tract or the in-channel islands protected as sanctuaries by the Delta Wetlands Project); (3) mitigation plantings shall be monitored for survival, plant numbers and area for a period of five years.

By implementing Mitigation Measure BIO-8, the Project Proponent would render the impact of the project on riparian habitat and other sensitive natural communities to a level of less-than-significant.

Mitigation Measure BIO-8: Orange construction fencing shall be installed around the perimeter of sensitive wetland and riparian habitats adjacent to the landward footprint of the project to prevent the movement of construction equipment into these sensitive areas during construction. A biological monitor shall make weekly inspections of the fencing during construction and shall notify the construction team if fence maintenance is needed.

By implementing Mitigation Measure BIO-9, the Project Proponent would reduce impacts on jurisdictional waters of the United States to a less-than-significant level.

Mitigation Measure BIO-9: Mitigation for the discharge of fill to wetland habitats shall meet the requirements established by the Corps, RWQCB, and DFG and may include one or more of the following:

a. The barges, in-river sheet piles and a portion of the rock placed around the barges to hold them in place shall be removed at the termination of the demonstration Project. The 0.18 acre of freshwater marsh wetland converted to other waters by the shading effect of the boat ramps and the 0.0023 acre of freshwater marsh habitat fill by the piers for the boat ramp shall be restored through the removal of the boat ramps and piers, and the replanting of native plant materials to restore freshwater marsh vegetative habitat to the site.

b. The discharge of fill to wetlands and other waters due to construction of the Project may be mitigated through 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.

c. Orange construction fencing shall be installed around the perimeter of wetlands and other waters in proximity to construction activities to prevent accidental disturbance during construction.

Additionally, the Project Proponent will be required to obtain a CWA Section 404 Permit, Section 401 Water Quality Certification, and Streambed Alteration Agreement, and will comply with any further mitigation measures that are imposed by the regulatory agencies in the process of issuing these permits.

Additionally, the Project Proponent will be required to obtain a CWA Section 404 Permit, Section 401 Water Quality Certification, and Streambed Alteration Agreement, and will comply with any further mitigation measures that are imposed by the regulatory agencies in the process of issuing these permits.

Mitigation Measure CR-1: The levees in the Old River and Connection Slough APE shall be appropriately documented prior to implementation of the Project using Department of Parks and Recreation site record forms. The eligibility of the levees for inclusion in the NRHP and the CRHR shall also be addressed by an archaeologist or historian meeting the Secretary of Interior's Professional Qualifications Standards. Implementation of this mitigation measure would result in a finding of "No Effect" or "No Adverse Effect" on the levees and would reduce impacts to less than significant.

Mitigation Measure CR-2: The Mandeville Island portion of the Connection Slough APE shall be surveyed by a qualified archaeologist prior to implementation of the Project. If cultural resources are identified in the area, they shall be adequately recorded and protected following guidelines presented in Section 106 and CEQA. Protective measures may include avoidance, preservation in place, excavation, documentation, curation, data recovery, or other appropriate measures. Implementation of this mitigation measure would reduce impacts to cultural resources within the Project APE on Mandeville Island to less than significant.

Mitigation Measure CR-3: If any prehistoric or historic artifacts, or other indications of archaeological resources are found once Project construction is underway, all work in the immediate vicinity must stop and Reclamation shall be notified immediately. An archaeologist meeting the Secretary of Interior's Professional Qualifications Standards in prehistoric or historical archaeology, as appropriate, shall be retained to evaluate the finds and recommend appropriate mitigation measures for the inadvertently discovered cultural resources. Reclamation shall consider the mitigation recommendations of the qualified archaeologist and a measure or measures to address the discovery shall be implemented. Such measures may include avoidance, preservation in place, excavation, documentation, curation, data recovery, or other appropriate measures. In addition, all construction personnel shall be alerted to the possibility of uncovering buried cultural resources and the protocol to address inadvertent discoveries shall be discussed through "tail gate" meetings or other format prior to Project implementation. Implementation of this mitigation measure would reduce impacts to inadvertently discovered archaeological resources to less than significant.

Mitigation Measure CR-4: If human remains are discovered are found once Project construction is underway, all work shall be halted immediately within 50 feet of the discovery, Reclamation shall be notified, and the County Coroner shall be notified according to Section 5097.98 of the State PRC and Section 7050.5 of California's Health and Safety Code. If the remains are determined to be Native American, the coroner shall notify the Native American Heritage Commission, and the procedures outlined in CEQA Section 15064.5(d) and (e) shall be followed. Implementation of this mitigation measure would reduce potential impacts associated with the unanticipated discovery of human remains to less than significant.

Mitigation Measure TRANS-1: The lead agencies will coordinate with the Contra Costa and San Joaquin County Sheriff's and Fire Departments to notify them of the construction schedule and identify alternative access methods if needed.