SECTION 2 Project Description

2.1 INTRODUCTION

2.1.1 Project Overview

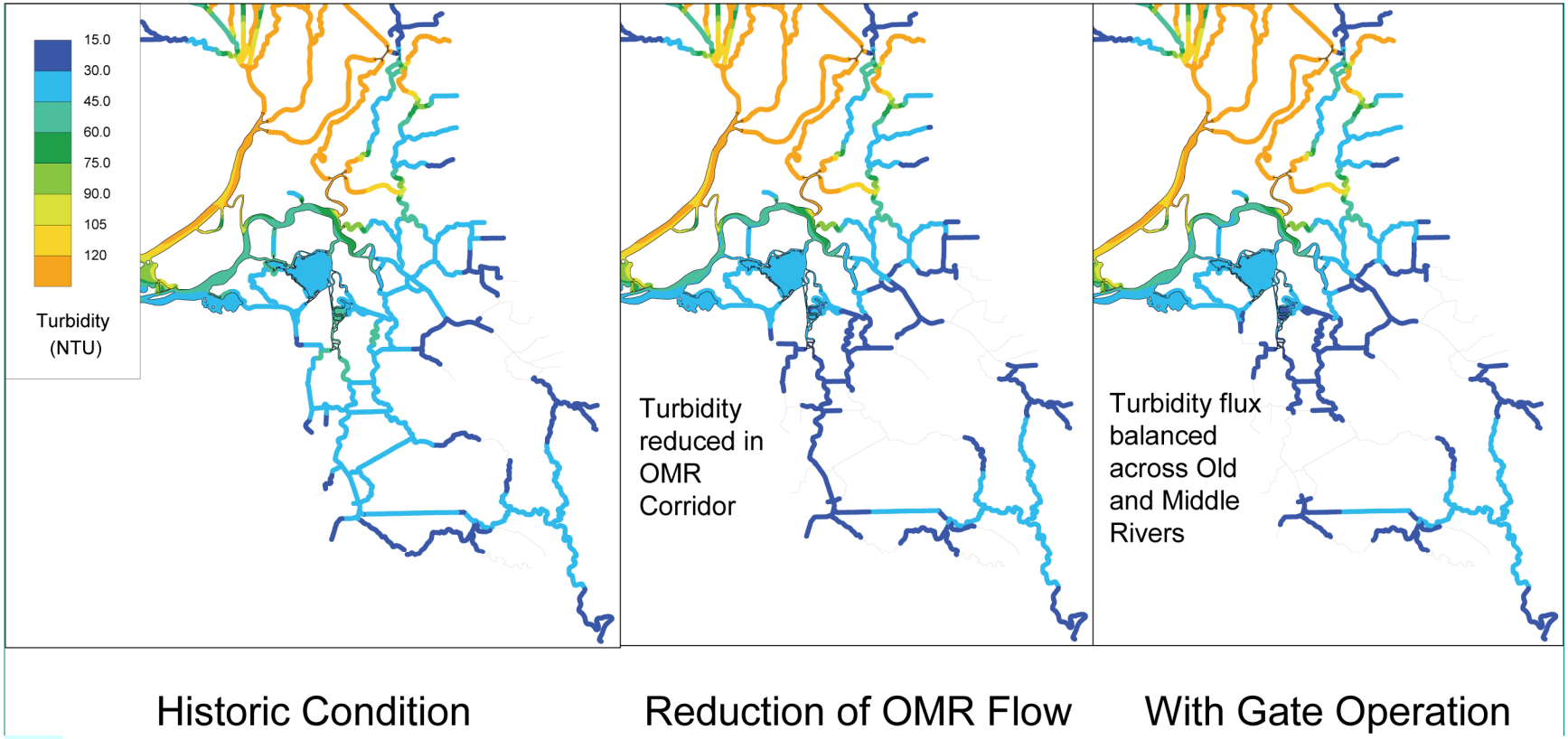
The 2-Gates Project is intended to provide temporary, cost-effective, immediate protection to delta smelt from entrainment in SWP and CVP export facilities by controlling the combined OMR flows. This would be accomplished by the installation of temporary "butterfly gates" in Old River and Connection Slough and operation of those gates when turbidity and salinity conditions are expected to support upstream movement of delta smelt.

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 would 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 included in Appendix A. Preliminary results from other newly developed adult delta smelt behavioral model applications further indicate that 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 2008b, NMFS 2009).

Entrainment reduction may be accomplished by controlling the distribution and continuity of turbidity and salinity conditions that have been identified in the USFWS OCAP BO (2008b) as a component of pre-spawning, adult delta smelt habitat. Preliminary results from the newly developed adult delta smelt behavioral model applications (Appendix A) suggest that operation of the 2-Gates Project), in concert with OMR flow restrictions (USFWS 2008b), could modify the the distribution and density of adults to reduce the potential for entrainment at the CVP and SWP export facilities (Figure 2-1). 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). 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 juvenilesmelt westward toward rearing habitat near Suisun Bay, and (3) enhance export of nutrients and phytoplankton to the west Delta. These

[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.

actions would benefit the species by reducing entrainment of pre-spawning adults. The 2-Gates Project benefits may provide operators the flexibility for the OMR flows to operate at above the minimum values specified in the OCAP BOs (USFWS 2008b, NMFS 2009).



[TLT1]

Figure 2-1 Modeled Balancing of Turbidity Flux along Old and Middle Rivers to Reduce Adult Delta Smelt Entrainment

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[TLT2]. Monitoring data would 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 and Monitoring Plan is included in Appendix B). Real-time adjustments to operations would be made as needed to reduce delta smelt entrainment while minimizing or avoiding impacts on other listed species. Monitoring also would 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 purpose of the proposed action is to test if two operatble barriers to be placed in Old River and Connection Slough can be operated to reduce entrainment of sensitive fish species at the State and federal pumps and, once proven to do so, allow for an increased ability to deliver water within existing permits and other conditions. 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 reduce entrainment of delta smelt by the SWP and CVP export facilities, either achieving or exceed the protection goals established by the OCAP BO for delta smelt (USFWS 2008b) while allowing OMR flows to exceed the minimum levels allowed by the RPAs described in the USFWS and NMFS OCAP BOs (by some an undefined amount) while complying with other water management requirements (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.

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 would be subject to separate environmental review and permitting processes, which would 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 would 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 of the gate facilities at the end of the five-year demonstration period. .

2.1.3 Need for the Project

The Project needs are: 1) provide protection from take of a listed species, 2) once protection is proven, provide water to users within existing permits and conditions, and 3) test the hypothesis that the proposed project will meet the stated objectives of the action and enhance the knowledge of delta smelt behavior. 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 (2008b) 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 cost-effective and immediate protection to delta smelt equaling or exceeding that provided by implementation of the USFWS (2008b) 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 (2008b) 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 would 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.

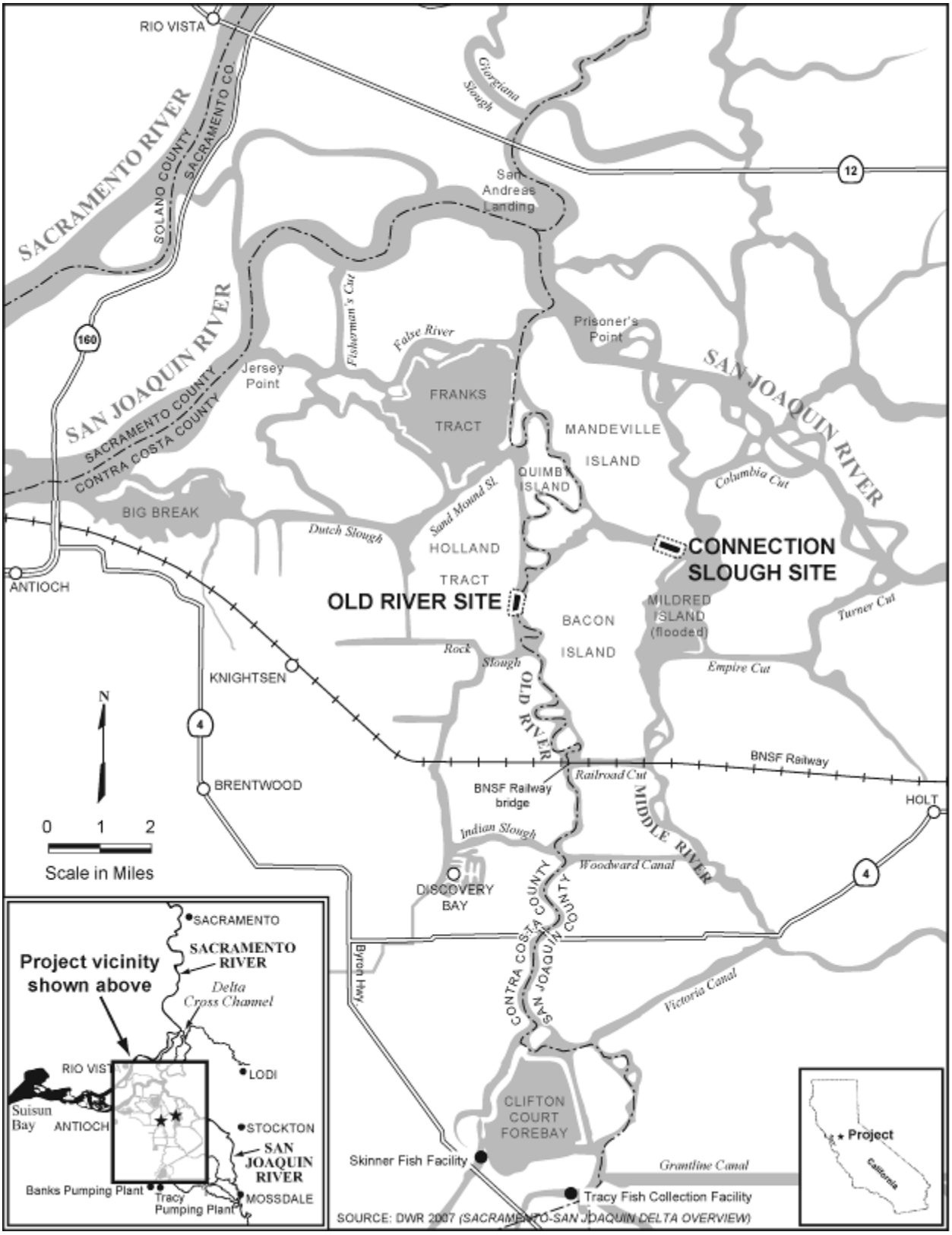


Figure 2-2 2-Gates Project, Regional Location

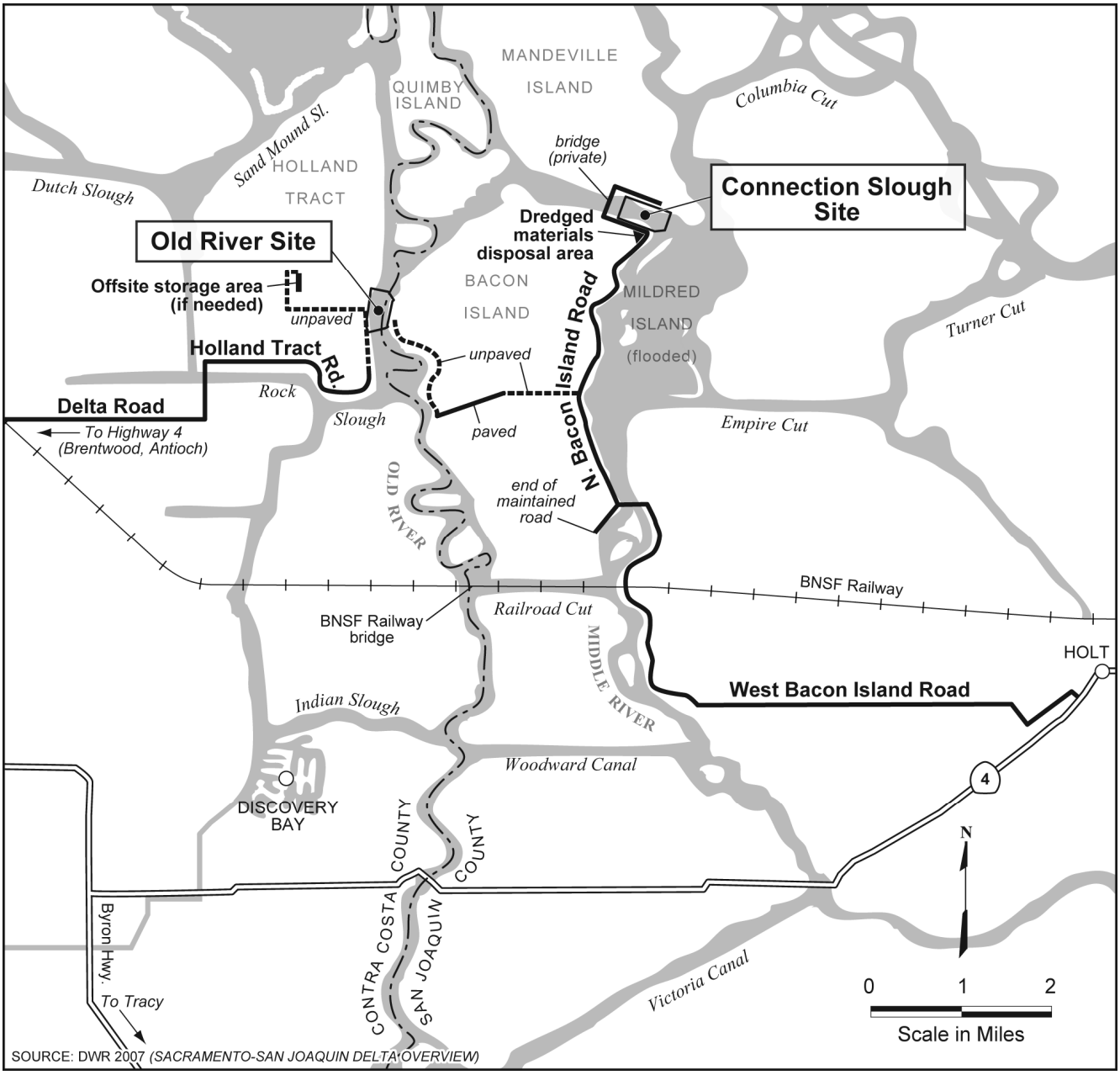


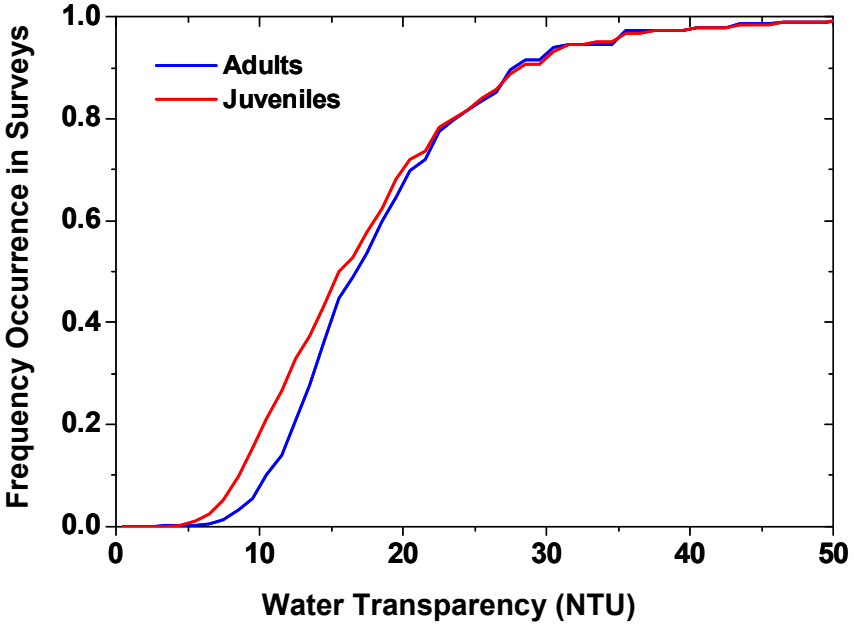
Figure 2-3 2-Gates Project Vicinity with Construction Access

2.1.6 Conceptual Foundation

Project design and operations are based on a conceptual understanding of patterns and relationships of Delta hydrodynamics, changes in the distribution and levels of turbidity and salinty, 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 primarily has 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, season, turbidity, and salinity. Recent evidence suggests low water transparency is a key characteristic of delta smelt habitat (Bennett 2005, Feyrer et al. 2007, Nobriga et al. 2008). Water transparency is an important predictor of occurrence for delta smelt. This relationship has been observed for adults (Spring Kodiak Trawl (SKT) data, Bennett 2009) and juveniles (20 mm survey, Bennett 2009; Fall Midwater Trawl, Feyrer et al. 2007). Figure 2-4 shows a compilation of years of delta smelt capture and water clarity data. Data are presented in a manner similar to an exceedance plot for river flows and show a low probability of encountering delta smelt when turbidity is low; there is an increased likelihood of delta smelt presence, and capture, as water turbidity increases. The recently released OCAP BO (USFWS 2008b) highlights the relationship between turbidity and delta smelt occurrence, particularly salinity (expressed as electrical conductivity or EC) of less than 400 micromhos per centimeter (µmhos/cm) and turbidity greater than 12 Nephelometric Turbidity Units (NTU).

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. in press). Turbidity in excess of 12 to 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 negative flows in the channels of Old and Middle rivers caused by export pumping. Review of fish salvage trends found a correlation in several years between elevated turbidity in the south Delta, high exports, and increased salvage (USFWS 2009) (Figure 2-5). 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 would 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.



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

Figure 2-4 Relationship between Occurrence of Delta Smelt and Turbidity

The adult distribution of delta smelt presumably affects the location of spawning and the spatial distribution of their progeny. This would 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 B, Attachment C). 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 River, 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, 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 operaitons. Turbidity also can move into the central Delta down Georgiana Slough and then is drafted up Middle River. When these turbidity sources (or the source from the San Joaquin River) meet, they form a turbidity "bridge" from the central and west Delta into the south Delta channels (Figures 2-1 (Historic Condition) and 2-5). 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 they relate 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 entraiment. Modeling suggests that OCAP actions to reduce OMR flows also dramatically reduce turbidity in these channels; however, they 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 to the effects of entraiment at the export pumping faciltities.

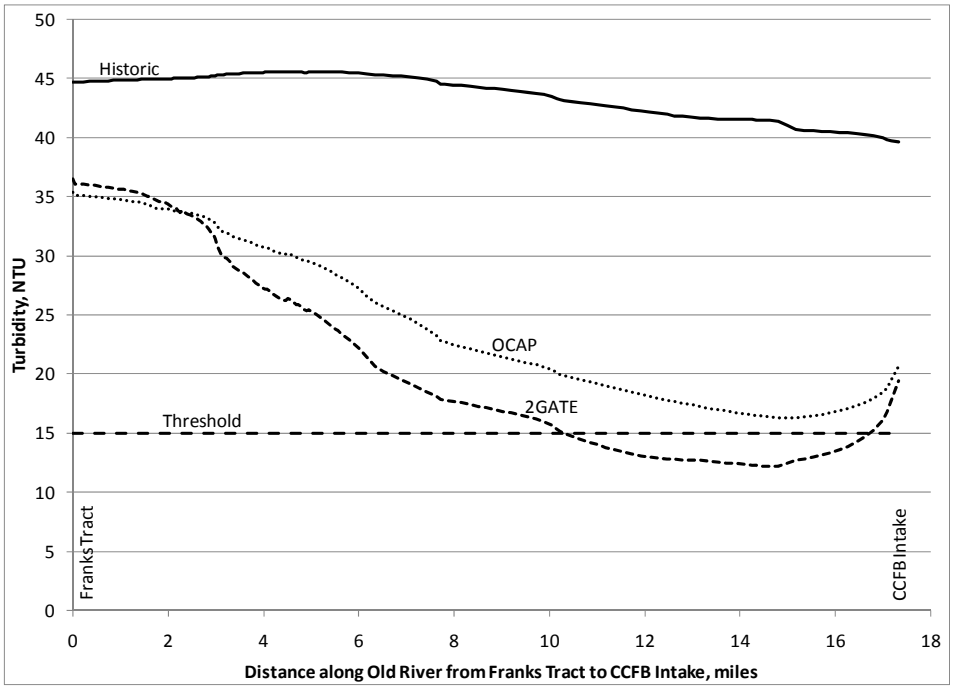


Figure 2-5 Longitudinal Profile of Modeled Turbidity along Old River from Franks Tract to Clifton Court Forebay

The proposed gates, when operated in conjunction with OMR flow requirements, may provide greater control and more flexibility in keeping turbidity away from the pumps.[PB3] Under existing conditions, Old River is a larger channel and is a faster path than Middle River for turbidity entering from the western Delta. Middle River, on the other hand, 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 by closing the gates in Old River and Connection Slough for short periods of 0.5 to 2.5 hours on portions of each flood/ebb tidal cycle, 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 through 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, while not changing affecting net flow in these channels (Figure 2-1). Entrainment reduction may 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 et al. in press). 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 modified to reduce their potential entrainment at the CVP and SWP facilities, in concert with OMR flow restrictions from the USFWS OCAP BO (2008b) 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 would 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 enhance mixing of water in the central Delta and disperse flows seaward toward the western Delta (Appendix A, Figure 7). 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 2-6). 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 have 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 et al. 2008). Dispersive mixing would cycle nutrients into the western Delta that otherwise would have been exported.

2.1.7 Questions Addressed by the Project

The 2-Gates 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 would 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 would 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. The two hypotheses developed regarding flow and turbidity effects of gate operations[PB4] include:

1. 2-Gates Project operations, coordinated with OMR flow restrictons, can control net flows in Old River to achieve a predictable balance of flows in between Old and Middle rivers.

2. 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:

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.

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

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

5. 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 would be used to evaluate the hypotheses, and 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 B, Monitoring and Science Plan.

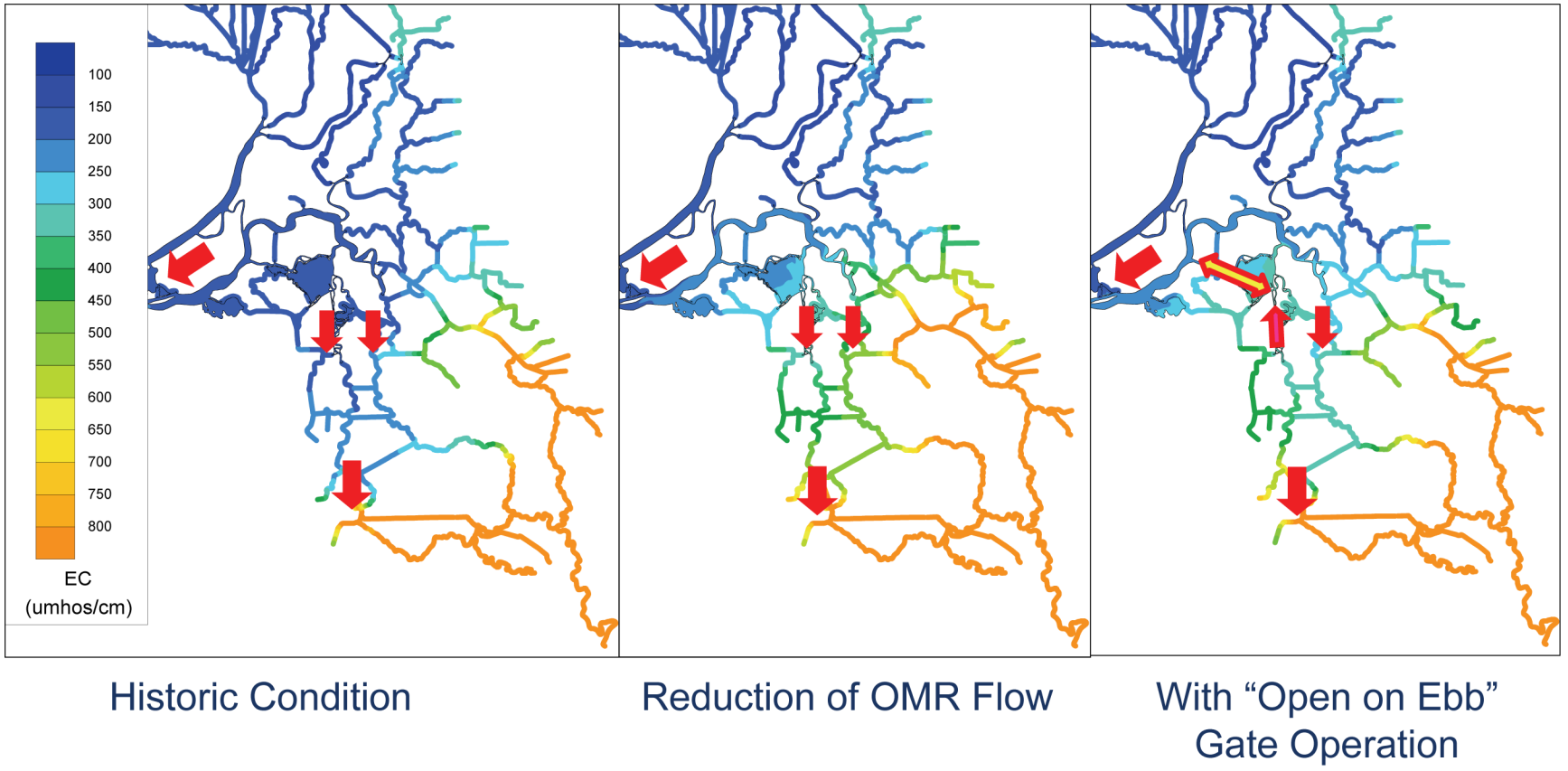


Figure 2-6 Operation of 2-Gates Project to Reduce Larval/Juvenile Delta Smelt Entrainment

Table 2-1 Hypotheses/Questions

No.	Hypotheses and Questions	Metrics [1]	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 [2].
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].
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 (Appendix A).
Balanced Flows and Turbidity			
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			
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 (Appendix B) • 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. Additional discussions are planned at the science panel.
2. 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.
3. 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

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 2-7 and 2-8, respectively. A conceptual view of the Old River operational gate system showing gates opened and closed is shown in Figure 2-9. Detailed design plan views, cross-sections, and layouts for the Old River and Connection Slough sites are included in Appendix C.

2.2.1 Gate Structures

Approximately 175-foot wide butterfly gates would be mounted on steel barges and ballasted into place on prepared beds in both the Old River and Connection Slough channels. The barges would be further held by large rocks (lock rock) placed along each side to provide additional resistance to lateral forces from tidal flows, and they would 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 would 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 would provide a 60-foot opening. Both sites would 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 would be +6.6 feet, the top of the sheet pile dikes would be +6.6 feet, and the top of the levees would be +10.5 feet. The gate sill (barge deck) elevation would be at approximately -19 to -20 feet at the Old River site and at approximately -13 feet at the Connection Slough site. An operator house would be constructed on each gate barge.

The barge supporting the gates at the Old River site would 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 at the Old River site would be between 12 and 18 feet, and between 12 and 18 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 ballasted 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.

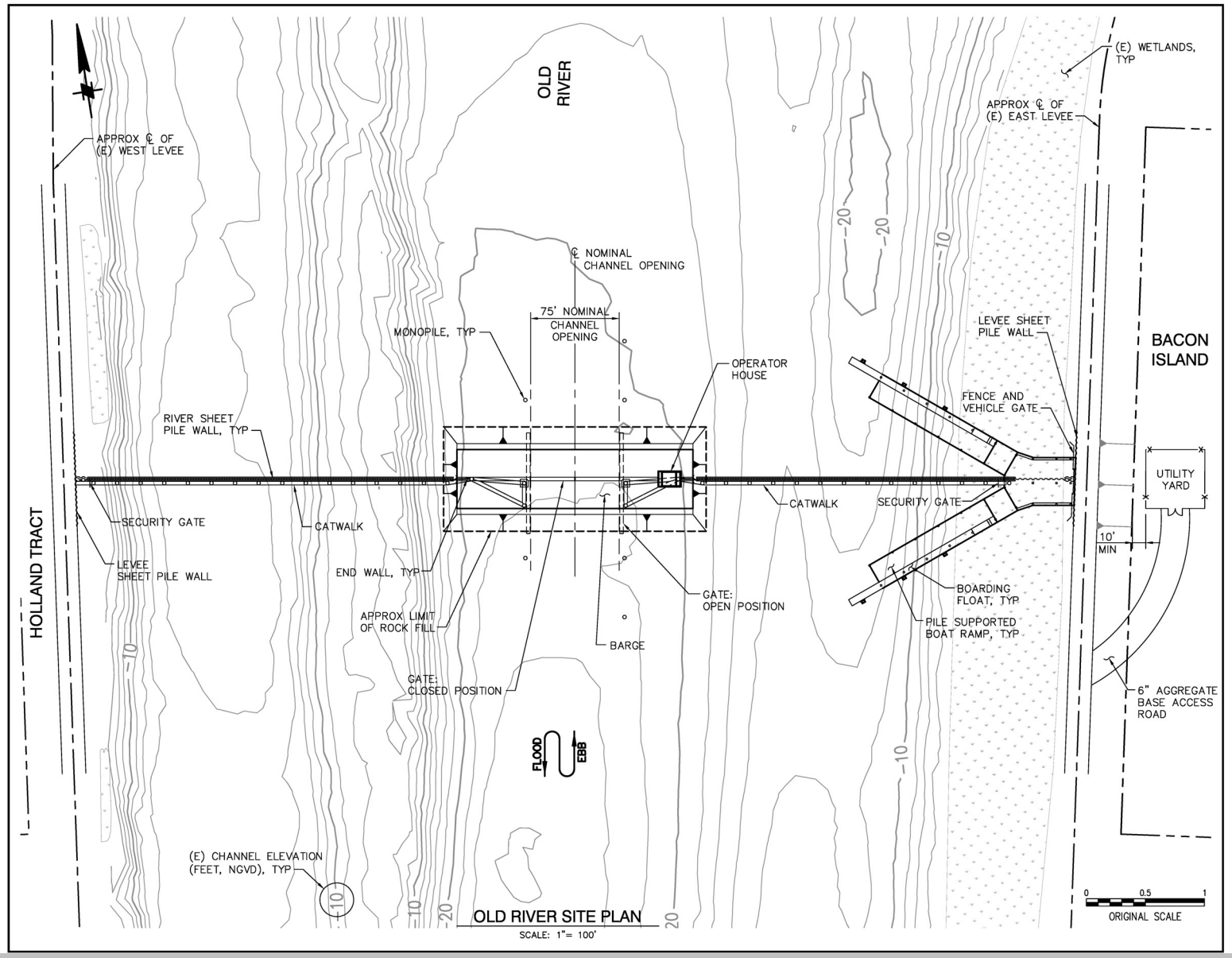


Figure 2-7 Old River Site Plan View

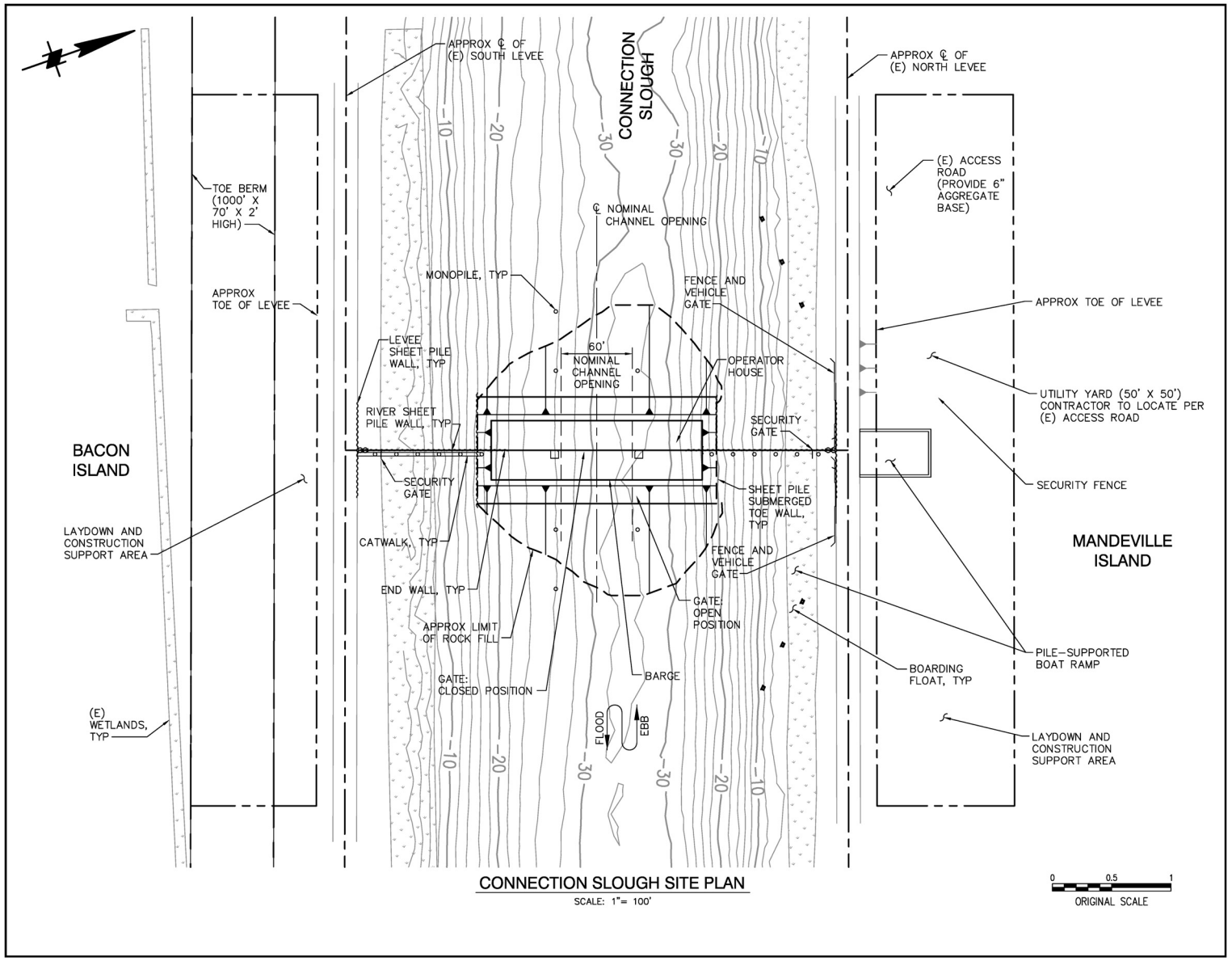


Figure 2-8 Connection Slough Site Plan View

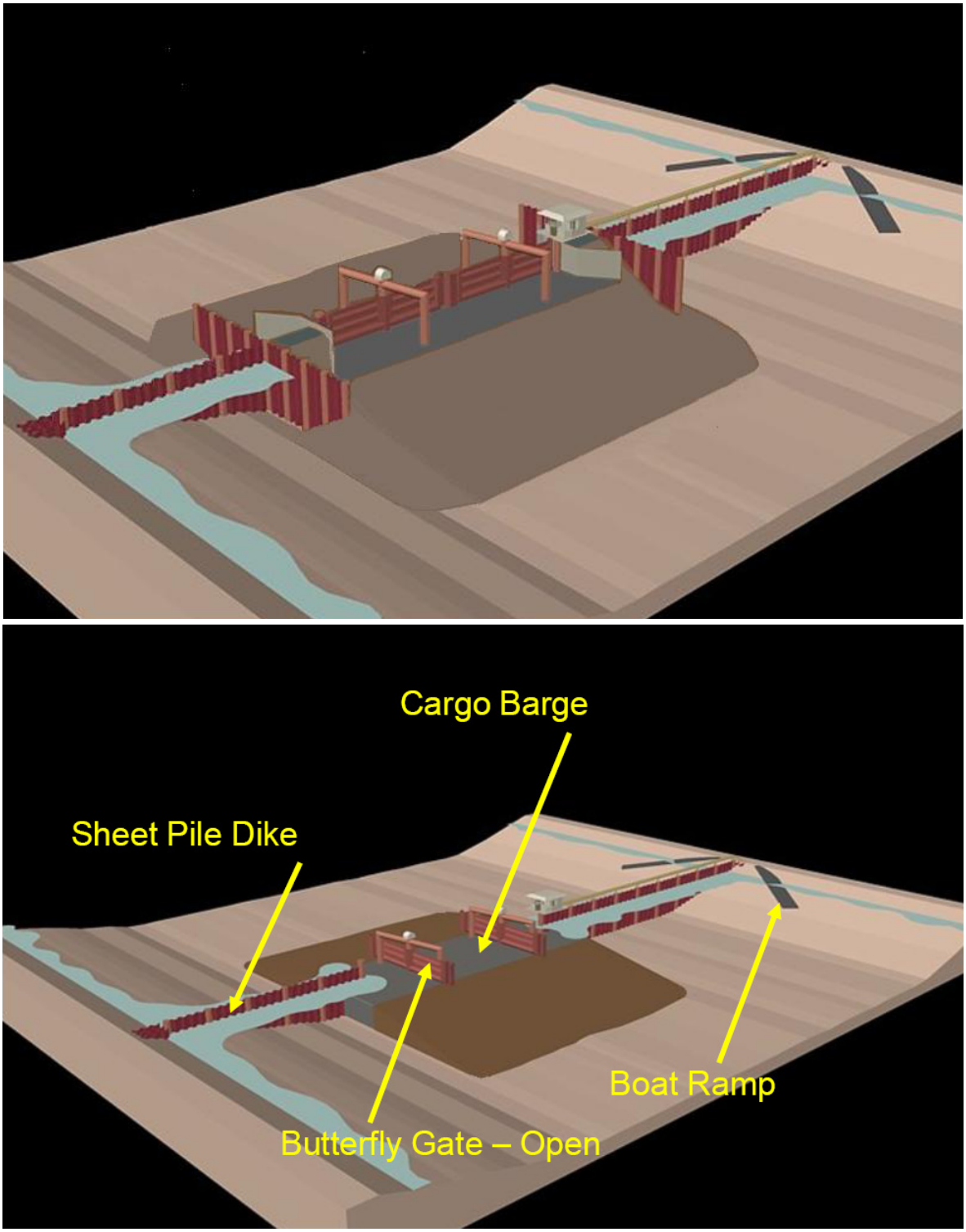


Figure 2-9 **Old River Slough Site Conceptual View Showing Gates Closed and Open**

2.2.2 Sheet Pile Wall

A sheet pile wall would 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 would 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 would be placed at both ends of the barge to anchor it to the river banks. The sheet pile wall would extend into the levees on both sides of the channel. An 80-foot perpendicular sheet pile dike would be installed into levees at each end of the sheet pile walls for approximately 40 feet on either side of the wall. Tying the sheet pile wall into the levee would require removal of a strip of existing levee slope protection material. At the gate barge end, a special end piece fabrication would be required to facilitate barge placement tolerances. The sheet pile wall would 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, sheet piles in lengths of 60 to 70 feet would be transported to the site on a barge and driven into the underlying sand layer. To complete the sheet pile wall, the sheet piles would be supported by 36-inch diameter king piles, set on approximately 20-foot centers at both locations.

2.2.3 Boat Ramps

Boat ramps (and associated small boat trailers and trucks) would be provided to facilitate portage of small boats around the closed gates when the gates are closed. Two pile-supported boat ramps would straddle the sheet pile walls at each of the two sites. Boarding floats would be provided alongside the ramps to facilitate staging of the boat launch and retrieval operation. The boat ramps would be tied into the existing levee roads and would require widening of the levee area to provide sufficient maneuvering space to accommodate launching and retrieving boats.

2.2.4 Levees

The levees would be bolstered on either side of the gates for a distance of approximately 50 feet using sheet piles and rock, consistent with the agreements with Reclamation District 2025 (Holland Tract), Reclamation District 2028 (Bacon Island), and Reclamation District 2027 (Mandeville Island).

2.2.5 Mechanical and Electrical Components

The barge would 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 this operation would be provided on a separate construction support barge. Once the barge was submerged, the construction support barge would be removed.

Power for the electrical system would 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 levees would be used. The generator skid

would be a self-contained system with generator, diesel engine, starter batteries, fuel tank, etc. Should the system need to run continuously for an extended period of time, an additional fuel tank skid with fuel pump could be required.

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

2.2.6 Navigation Markers

Signage would comply with navigation requirements established by the U.S. Aids to Navigation System and the California Waterway Marker system as appropriate. A boat safety exclusion zone would be established to keep 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 would be installed to indicate that the center opening (between the gate pivot posts) is the only navigable opening in the structure, and the side openings are not to be used.

2.2.7 Fender System

A fender system would protect the gate structures from potential vessel impact. The fenders would consist of six steel mono-pile dolphins constructed at each site. Three fenders would 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 would enter the channel aligned with the gate opening and would not change direction until they passed through the gate structure.

2.3 PROJECT CONSTRUCTION

Construction of the gate structures would involve dredging the barge foundations and refilling them with crushed rock. Sheet pile dikes would be installed, and the barges then would be sunk to the foundations and keyed into the sheet pile walls. Rock would be added to the sides of the barges and at each end to the lock the barges in place. Boat ramps would be constructed at each site, and the existing levees would be widened to accommodate activities at the boat ramps. The Project would be built primarily from the water, using barges and other vessels within the river channels. Materials would be brought to the site by barges. Some construction also would take place from the levees; for example, boat ramps would be constructed on one adjacent levee at each gate site. The following describes the major construction practices that would 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 would be needed for construction of the gate structures, boat ramps, and abutments, and to tie-in the sheet pile walls to sheet piles in the levees. They also would be needed for any other land-side facilities such as generators, equipment storage, and for parking by construction personnel and operations staff. Laydown areas would be required for the initial staging of rock and sheet pile used on the levees. The general geographic areas in which rights would be needed for construction and laydown are shown in Figure 2-3, 2-7, and 2-8. The location of the alternate storage area on Holland Tract shown on Figure 2-3, and the dredged material disposal area on the Bacon Island side of Connection Slough, located as required by Reclamation District 2028, is illustrated in Figure 2-10.

2.3.2 Dredging and Rock Placement

Prior to the installation of the barge-mounted gate system, a barge-mounted clamshell dredge would remove the unstable peat material from the channel bottom, and a gravel sub-base foundation would be installed. Dredging would extend to a depth of between -33 and -40 feet at the Old River site and -35 feet at the Connection Slough site. Dredging would 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. The dredging plans for the Old River and Connection Slough sites are shown on Figures 2-11 and 2-12, respectively.

Dredged material would 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 2-10). Dredged material from the Connection Slough site can be sidecast over the levee into the disposal area on Bacon Island. Material from Old River would need to be placed on a barge, moved to the disposal area, and offloaded over the levee at the Bacon Island disposal site. The disposal area would be surrounded by a low berm in order to contain any runoff.

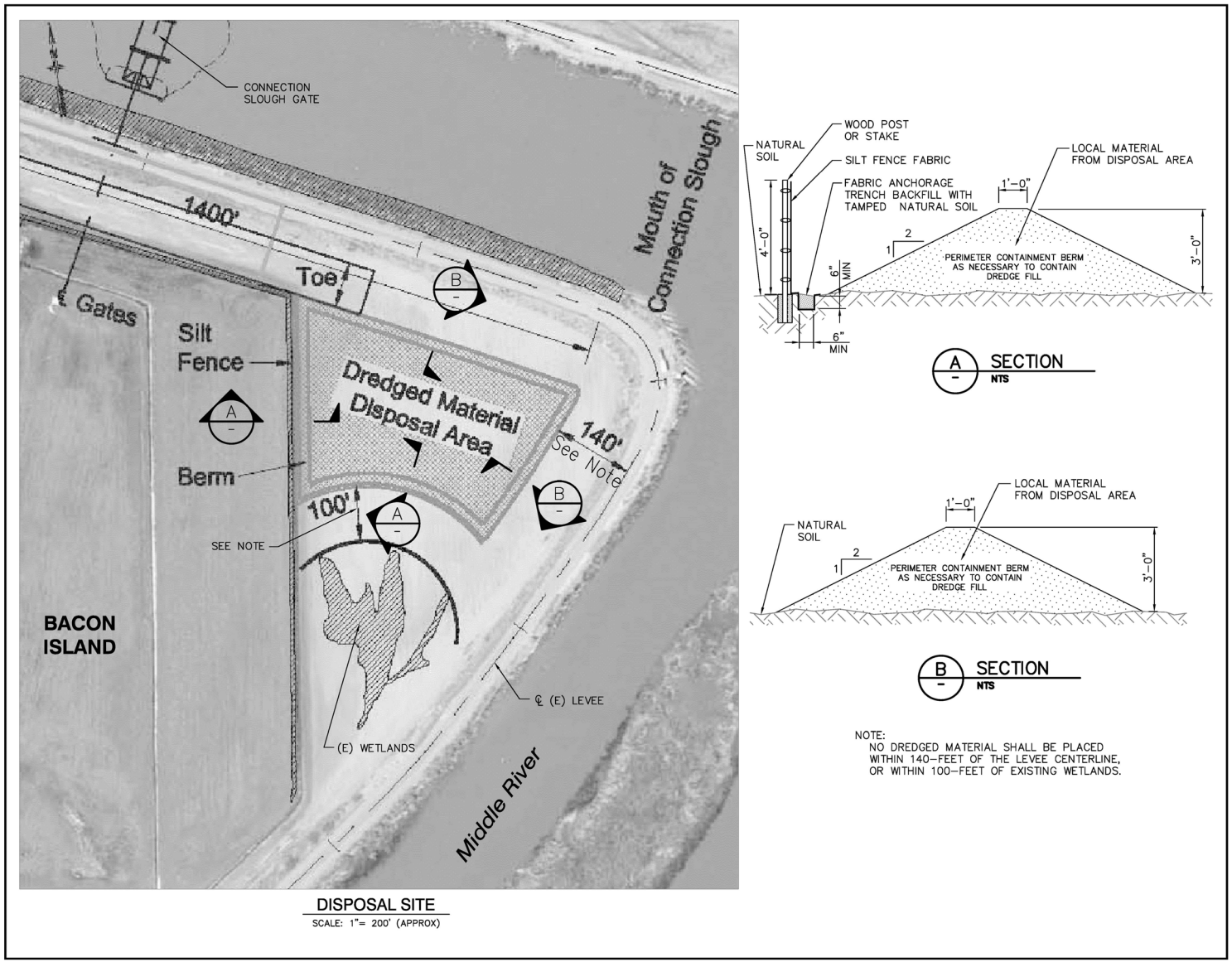


Figure 2-10 Dredged Material Disposal Site

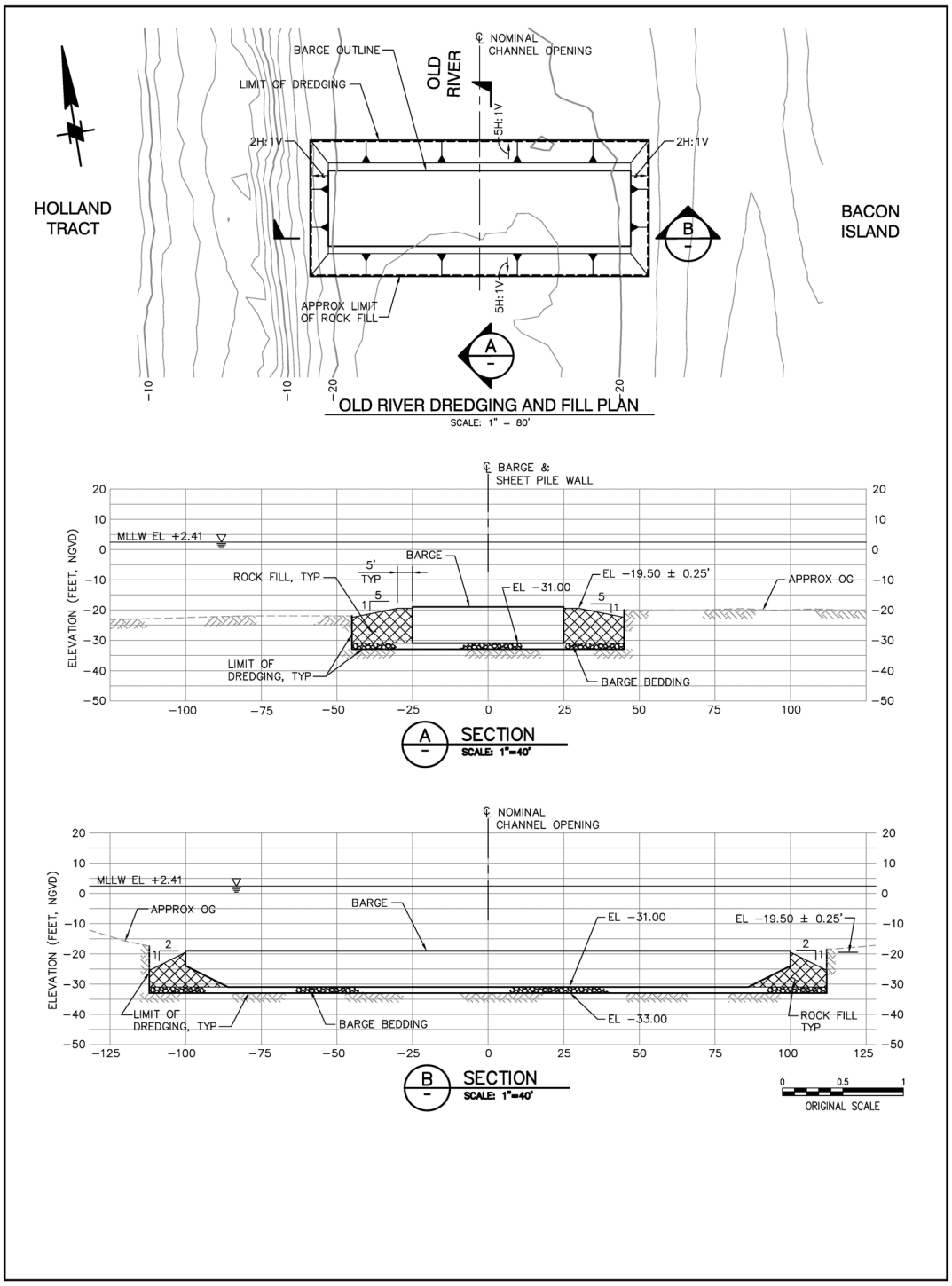


Figure 2-11 Old River Dredging and Fill Plan

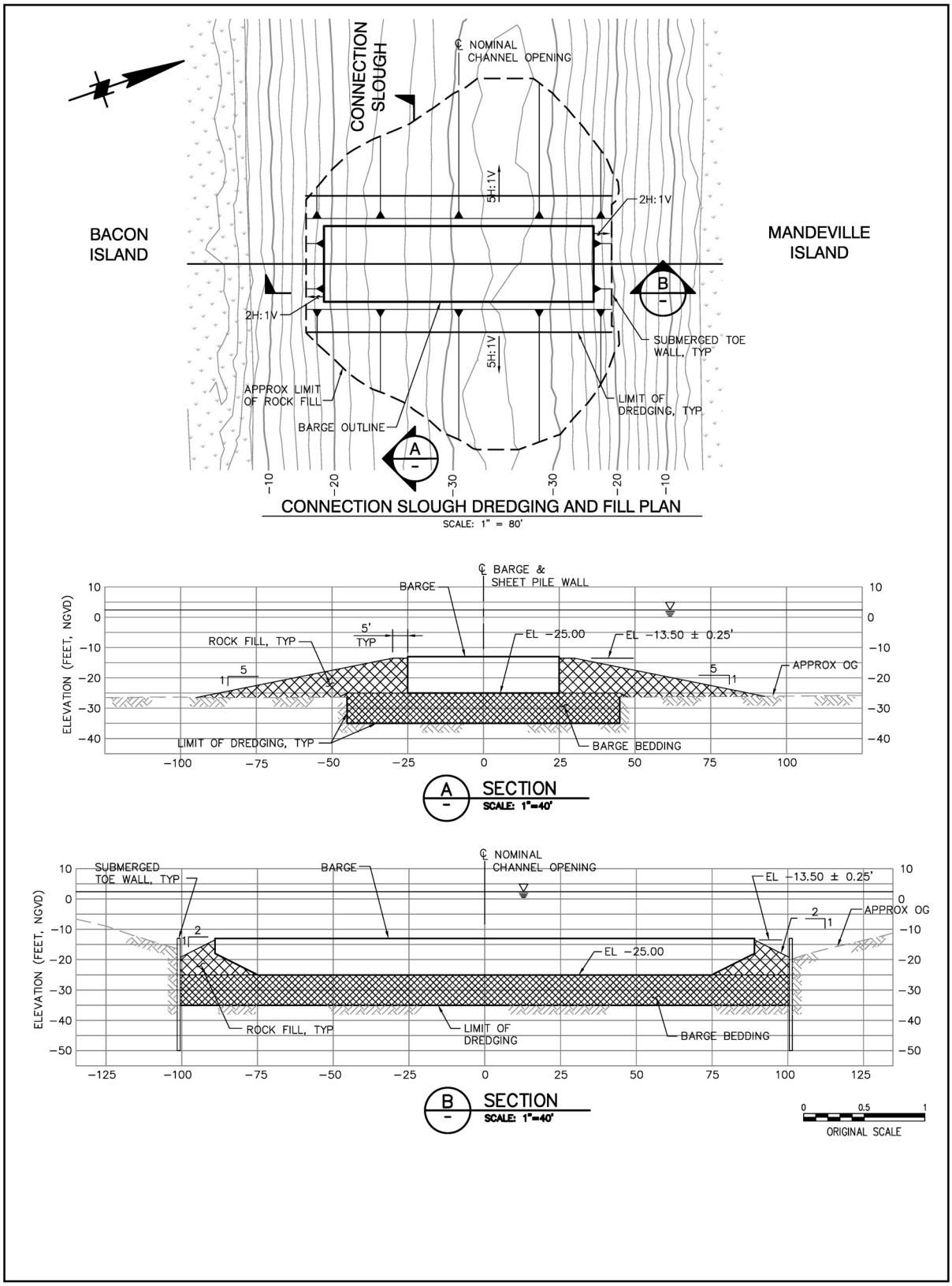


Figure 2-12 Connection Slough Dredging and Fill Plan

2.3.3 Sheet Pile Walls

Sheet piles would be installed using vibration driving techniques, although king piles would 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. If an impact hammer is used, the following provisions would be followed in order to minimize impacts on aquatic species.

- For piling in less than 1 meter water depth, piles may be driven without the use of a confined bubble curtain, and no underwater sound level monitoring is required.
- For piling in greater than 1 meter water depth, one piling would be driven without the use of a confined bubble curtain. Underwater sound levels would be monitored at a depth of approximately 3 meters and a distance of 10 meters from the pile being driven. Three additional piling would be driven within a confined bubble curtain. Underwater sound levels would be monitored at a depth of approximately 3 meters and a distance of 10 meters from the piling being driven. If sound levels do not exceed 187 dB RMS or 207 dB Peak at this location, pile driving may proceed, but a confined bubble curtain would be used at all times. If sound levels exceed 187 dB RMS or 207 dB Peak at this location, pile driving would be restricted to the period between one hour prior to slack water and one hour following slack water, and a confined bubble curtain would be used.

2.3.4 Gate Barge Construction and Installation

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

2.3.5 Construction Power Supply

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

2.3.6 Access

Most of the construction (e.g., dredging, placement of rock, and driving sheet pile) would 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 would 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 would 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 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 were damaged as a result of construction equipment or truck use would be restored to pre-construction conditions once construction was completed. Additionally, it may be necessary to grade and apply 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 would maintain vessel access during construction. Notices of construction would be posted at local marinas and in the Local Notice to Mariners. Navigational markers would be used to prevent boaters from entering the immediate construction area, and speed limits would be posted. Safe vessel passage procedures would 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 would 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 would include notices in local newspapers and boater publications as appropriate; notices also would be posted at local marinas and boat launches and on the Project website (http://www.baydeltalive.com/?page=Projects&subpage=Project%20Page&view=Project%20Page&id=563).

2.3.8 Construction Schedule

The 2-Gates Project facilities would be installed in the fall of 2009 during the window for in-channel activities that was established by 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 would be completed in about seven weeks. It would take place in the fall of 2009 in order to minimize impacts to sensitive aquatic and terrestrial resources as well as to avoid peak recreational use periods (Table 2-2). Site preparation prior to the placement of the barges would require about one month. This includes dredging the foundation areas of the barges, placing rock in the dredged area, and the installation of sheet pile walls. Placement of the barges would occur at the end of the site preparation period; approximately about two weeks would be required to install each barge. Sheet pile installation would most likely be conducted during daylight hours only; dredging would be conducted 24 hours per day, as would rock placement and gate barge installation. Additional construction site details are presented in Appendix C.

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

The protocols for operating the gates are based on a 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 D). Gate operations would begin as early as December each year when smelt distributions are located north and west of the Project facilities as determined by flow, turbidity, salinity, and biological data collected by Project monitoring. [RDT5]

The Project would be operated by Reclamation or its designee in a manner that is consistent the operations of the OMR flow restrictions under the OCAP RPAs. Table 2-3 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 2.7 and the Operations Plan (Appendix D).

Table 2-3 Summary of RPA Actions1 and 2-Gates Operations

Month	2-Gates	2-Gates	USFWS Action 1	USFWS Action 2	USFWS Action 3	NMFS Action IV. 2.1[ROS6]	NMFS Action IV. 2.3
	1. Pre-spawning Adult Delta Smelt entrainment protection	2. Larval and juvenile delta smelt entrainment protection (dispersive mixing)	Adult delta smelt migration and entrainment (first flush)	Adult delta smelt migration and entrainment (extended protection)	Entrainment protection of larval delta smelt	Maintain SJR Inflow/Export ratio	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					

Note:
1 USFWS 2008 OCAP BO RPA 1 and NMFS 2009 OCAP BO RPA Action IV.2

1

2.4.1 Factors Considered in Project Operations

2.4.1.1 Hydrodynamics and Water Quality Factors Affecting Smelt Entrainment

Historical entrainment of delta smelt at the export facilities has primarily occurred during the period of December through June. The recently released OCAP BO (USFWS 2008b) identifies the linkages between turbidity and delta smelt occurrence. Adult delta smelt pre-spawning distribution is believed to be strongly related to specific ranges of salinity and turbidity. Water quality conditions characterized by electrical conductivity less than 400 µmhos/cm and turbidity greater than 12 NTU are associated with the occurrence of delta smelt. Delta smelt seeking these conditions are thought to move into the central Delta by surfing the tides to remain in areas of suitable water quality. Under the current configuration of the south Delta, high exports during early winter can cause net flow reversals of Old and Middle rivers, drawing water with the water quality conditions identified above into the south Delta. These conditions can lead to entrainment of pre-spawning adult delta smelt in SWP and CVP export facilities. In addition, adult delta smelt spawning dispersal into the south Delta would likely result in a high risk of entrainment for their progeny due to the proximity of the export facilities.

2.4.2 Gate Operation Protocols

The 2-Gates Project operating plan is sufficiently flexible to adapt to real-time monitoring and predictive hydrodynamic, water quality, and delta smelt behavior modeling (Appendix D). 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 2-4). 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 2-4 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 [PB7]NTU at San Joaquin River at Jersey Point. • Off-ramp – Water temperatures ≥ 12 degrees C or "spent" female smelt detected in SKT or salvage.
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 SKT 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 open continuously to allow fish movement and navigation. • Monitoring for triggers for adult operations resumes in December.

The protocols for operating the gates are based on a conceptual understanding of factors affecting smelt entrainment, as described earlier, and refined through hydrodynamic and behavioral modeling. Currently, there are two operational periods, based on delta smelt life-stage-specific objectives and season under the USFWS OCAP BO (2008b): (1) pre-spawning adult protection and (2) larval and juvenile protection. Gate operations would begin as early as December each year when smelt distributions are located north and west of the Project facilities as determined by flow, turbidity and salinity, and biological data collected by Project monitoring.

The anticipated operations planned for the initial year are discussed below. Operations in subsequent years or within the initial operational year could be adjusted, based on monitoring data, to improve project effectiveness and to refine hypotheses.

Operational Triggers and Off-Ramps

The start and conclusion of each operational period are triggered by specific water quality conditions (turbidity, temperature), date, and/or natural history (evidence of spawning.

Turbidity (≥12 NTU) is the trigger for initiating adult protective measures for both the 2-Gates Project and OCAP RPA. The RPA 1 trigger, limiting OMR flows to -2,000 cubic feet per second (cfs), is based on turbidity conditions in the Delta. When the three-day-average turbidity from the historical simulations at each of three stations (Prisoner's Point, Holland Cut, and Victoria Canal is ≥12 NTU, RPA 1 will be triggered. If historical smelt salvage data shows an increase in salvage before this turbidity trigger is reached, RPA 1 may begin sooner based on a qualitative assessment of the salvage data. The 2-Gates Project uses turbidity data from a different location, namely when turbidity reaches 12 NTU at the San Joaquin River at Jersey Point (Jersey Point). This turns out to be from 3 to 21 days earlier than the RPA 1 trigger for the OCAP simulations. Using Jersey Point data provides more advance warning of conditions that are expected to trigger pre-spawning adult smelt migration, and thus allows more response time for decisions about gate operations.

Water temperature is used as the trigger for measures to protect larval and juvenile delta smelt. RPA 2, adjusting the OMR limit to -1,250/-5,000 cfs, is triggered by observed temperature data and or confirmation that delta smelt have begun spawning. When daily mean water temperatures at Mossdale, Antioch, and Rio Vista are ≥ 12° C, RPA 2 begins. RPA 2 may also be triggered if spent female delta smelt are detected in SKT or salvage. RPA 2 can be suspended any time the

three-day average flow on Sacramento River at Rio Vista is ≥ 9,000 cfs and the three-day average flow on the San Joaquin River at Vernalis is ≥10,000 cfs between the start of RPA 2 and June 30, or it can be suspended earlier due to daily average water temperatures reaching 25° C for three consecutive days at Clifton Court Forebay. The 2-Gates Project utilizes these same triggers.

Data on triggers (turbidity, temperature, average daily flow) would be provided from fixed monitoring stations in the Delta, as described in the Monitoring Plan (Appendix B). If an information gap occurs during real-time monitoring of a particular trigger, such as turbidity at Jersey Point, data from surrounding stations and sources would be used to provide information for decision-making. These include turbidity at other stations, especially upstream of Old and Middle rivers, flow information for the Sacramento River and other incoming tributaries (indicating conditions that would result in a first flush event or a pulse of rising turbidity and flow), and storm forecasts.

Salvage would not be used as a trigger to commence adult gate operations because it is not an early warning indicator (leading indicator), but rather a direct measure of effectiveness of the RPAs and 2-Gate operations (lagging indicator). Salvage data does provide valuable feedback for guiding gate operations and exports, testing hypotheses, and adaptive management.

Adult Delta Smelt (December through March)

Objective: To provide equal or improved protection of pre-spawning adult delta smelt from entrainment with early operation of the Project facilities and early implementation of RPA Action 1, and once demonstrated to be an effective tool for the protection of delta smelt, to allow SWP and CVP water exports to increase while operating within the required OMR flow range established by the OCAP BO (USFWS 2008b) and all other water management requirements.[ROS8]

Action: To protect pre-spawning adult delta smelt as they migrate inland, the gates would be operated from the onset of the higher turbidity conditions December into March. After December 15, gate operations and RPA Action 1 would begin when turbidity at Jersey Point exceeds 12 NTU. This is an earlier triggering of OMR flow control and other Project facilities. Operate gates in Old River and Connection Slough to balance flows in Old River and Middle River in conjunction with RPA Action 1 in order to maintain a low turbidity zone (<12-15 NTU) in Old River and Middle River between the central Delta and the south Delta export facilities (Hypothesis 2) (see Appendix D). The gates would be closed 0.5-2.5 hours daily in advance of a forecast high turbidity event. Gate operations would occur within the bounds of the OMR flow requirements during this period[2], which are average daily OMR flow[3] no more negative than -

[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.

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 would be rerun in response to real-time turbidity data as needed to detect upcoming high turbidity events.

Timing: The adult operations would occur December into March. Forecast modeling would commence December 1, with gate operations commencing with the first flush in December. However, the SWG could recommend an earlier start or interruption based on other conditions such as Delta inflow that may affect vulnerability to entrainment. The 2-Gate adult operations would occur concurrently with the FWS OCAP RPA Actions 1 and 2.

Triggers:

- Turbidity - Commence gate operations when turbidity ≥ 12 NTU at San Joaquin River at Jersey Point. Monitor turbidity at stations along Old and Middle rivers to determine how far the more turbid water extends toward the south Delta.

- Salvage – Cease gate operations if three days of delta smelt salvage after December 20 at either facility or cumulative daily salvage count is above a risk threshold, based upon the "daily salvage index" approach reflected in a daily salvage index value ≥0.5 (daily delta smelt salvage > one-half prior year FMWT index value).

Scenarios:

- If turbidity levels drop below 12 NTU along Old and Middle River stations for three days following a high turbidity event, this would indicate that turbidity has settled out and water is clearer. Cease gate operations and leave gates open, but continue to monitor turbidity at Jersey Point for later pulses of turbidity and any additional migrating adult delta smelt.

- If turbidity levels increase above 15 NTU throughout Old and Middle rivers, as measured at several stationary monitoring sites[4], this would indicate that the high turbidity plume as extended down to the South Delta and there is no low-turbidity zone that delta smelt would avoid. Cease gate operations but continue to monitor turbidity at Jersey Point and along Old and Middle River to see if turbidity levels drop below 12 NTU. If this occurs, resume monitoring for turbidity (≥ 12 NTU at Jersey Point) to trigger gate operations for adults.

- If salvage or SKT surveys document adult delta smelt in the south Delta or at the export facilities, this would indicate that the low turbidity zone was not maintained or was ineffective at reducing delta smelt movement toward the export facilities.

- Water supply - If there is a clear-water low turbidity zone (<12 NTU) on Old and Middle rivers (<12 NTU at OLD and MID stations) and salvage rates are at an acceptably low

[4] Monitoring sites for turbidity distribution along Old and Middle rivers include existing stations (OR at Franks Tract, Holland Cut, OR at Bacon Island, MR at Columbia Cut, MR at Bacon Island, and Victoria Canal), and new stations that will be established (OR at Old River gate, OR at Woodward Island, OR at Victoria Island, MR at Connection Slough gate, MR at Woodward Island, MR at Victoria Island).

level for the last 3 days (as defined by the SWG), then the SWG can consider allowing exports to increase (but still remaining within RPA 1 limits on negative OMR flows). The SWG will make a recommendation to the USFWS, which would make the final determination regarding timing and level of OMR flow.

Off-ramps:

- Temperature - Water temperature reaches 12°C based on a three station daily mean at Mossdale, Antioch, and Rio Vista. The temperature range of 12-18ºC is the range in which most successful delta smelt spawning occurs (FWS 2008). The water temperature threshold (≥ 12ºC) signals a transition from adult to larvae/juvenile delta smelt management actions.

- Biological: presence of spent females in SKT or salvage facilities.These operations will be continued until water temperatures ≥ 12ºC (3-station daily mean at Mossdale, Antioch and Rio Vista) or until hydrodynamic forecast modeling indicates that Project operations would not benefit adult delta smelt distribution relative to potential entrainment by the SWP and CVP pumping facilities.

Rationale: Hydrodynamic modeling results indicate that the gates should be closed about an hour per day, to balance flows between Old and Middle rivers in order to manage the turbidity plume and presumably adult delta smelt distributions. Behavioral modeling has shown that the 2-Gates Project, in conjunction with OMR flow restrictions (RPA Actions 1 and 2) is effective in preventing the formation of turbid conditions that are linked to pre-spawning movement of delta smelt generally within the central Delta, thereby reducing the entrainment of delta smelt at the CVP and SWP pumps. These early 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 pumps. Hydrodynamic forecast modeling would inform the decision regarding initiation and conclusion of this operation period.

There are real-world limitations to successfully managing turbidity distribution in the Delta, including the occurrence of infrequent and unplanned events occur at unpredictable times. For example, turbidity associated with very large San Joaquin outflow that does not coincide with a similar event on the Sacramento watershed may overwhelm the ability to maintain a low turbidity region in the Old and Middle River corridor. Also, when Delta outflows are high, adult delta smelt are located far west of the central Delta and entrainment vulnerability is low.

Larvae/Juvenile Delta Smelt (March through June)

Objective: To provide equal or improved protection of larval and juvenile delta smelt from entrainment by increasing dispersive mixing to enhance downstream transport, and once demonstrated to be an effective tool for the protection of delta smelt, to allow SWP and CVP water exports to increase while operating within the required OMR flow range established by the OCAP BOs (USFWS 2008b) and all other water management requirements.

Action: The gates would be operated tidally to increase dispersive mixing from the central and south Delta toward the western Delta. The Old River gate will be closed on flood tide (twice daily, about 10 hours total daily) and open on ebb and slack tides (~14 hours daily). Connection

Slough gate will be closed about 20 hours and open during slack tide (~ 4 hours daily). Net daily OMR flow will be no more negative than -1,250 to -5,000 cfs based on a 14-day running average with a simultaneous 5-day running average within 25 percent of the applicable requirement for OMR. A real-time hydrodynamic and delta smelt distribution forecasting system for juvenile and larval delta smelt will used to forecast optimum Project operations for dispersive mixing as a means of protecting juvenile and larval delta smelt. Monitoring of salinity (EC) and flow at different stations will be used to measure the flux of

Timing: The larval and juvenile operations begin in March immediately after pre-spawning adult operations likely in March. This gate operation schedule would be suspended for April and May, and the gates will be open continuously April 1 through May 31 to coincide with the San Joaquin salmon and steelhead outmigration period as defined in the NMFS OCAP BO (NMFS 2009, RPA IV.2.1). Gate operations would resume for the month of June. Based upon daily salvage data, the SWG may recommend an earlier start to RPA Action 3, which may lead to an earlier start of 2-Gates larval and juvenile operations. The Service would make the final determination.

Triggers:

- Temperature - daily mean water temperatures ≥ 12ºC at three stations (Mossdale, Antioch and Rio Vista).
- Biological - Onset of spawning indicated by presence of spent females in SKT or in salvage at either facility.

Scenarios and Alerts:

- If the distribution of larval or juvenile delta smelt (20mm survey) or juvenile salmon (SKT) were more in the eastern Delta than central Delta, then consult with SWG and DOSS and cease gate operations for dispersive mixing because the flows from this region of the Delta would trend toward the south and the export pumps.
- If juvenile salmonids from the Mokelumne River (acoustic tagging) were found in the south Delta (acoustic tagging, SKT) or in salvage, then consult with DOSS, cease gate operations and evaluate.

If salvage reaches OCAP RPA trigger levels for delta smelt or salmonids, then consult SWG and DOSS and evaluate whether to continue gate operation.

Off-ramps:

- Temperature: Water temperature reaches a daily average of 25ºC for three consecutive days at Clifton Court Forebay. This is close to the thermal maxima for delta smelt (Swanson et al. 2000).
- Temporal: June 30. Gates would be open continuously July 1 through November 30 to allow fish movement and navigation.

Rationale: To provide added protection to larvae/juvenile delta smelt, the gates would be operated to enhance dispersive mixing for downstream transport. Gate operations for larvae/juvenile smelt would take place during March and June. During this period, the OMR flow requirements are -1,250 cfs to -5,000 cfs (RPA 2 from the USFWS 2008 OCAP BO). From

April 1 through May 31, the gates will not be operated, and would remain in a fully open position, to coincide with the San Joaquin salmon and steelhead outmigration period as defined in the NMFS OCAP BO (NMFS 2009, RPA IV.2.1). In some years, conditions may occur when very large San Joaquin inflow may overwhelm tidal flows in the Old and Middle river channels. This would mask the effects of the Project.

2.4.2.1 July through November

The gates would not be operated from July through November, and would 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.

2.4.2.2 Vessel Access

The lead agencies would 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 at local marinas. As noted in Section 2.3.7, an educational program would be implemented to inform boaters of the purpose of the Project, scheduled closures, and operational characteristics of the gates. The USCG also would update navigation charts as appropriate. Details regarding the anticipated schedule for gate openings and closures are included in Table 2-4.

Gate operators would staff the gates 24 hours a day, seven days a week while the gates were being operated. Their phone numbers would 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 would open the gates as needed for emergency situations and to allow access by commercial vessels (commercial vessel operators would 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 would be allowed to portage around the 2-Gates facilities by using the boat ramps and small boat trailer facilities that would be provided. As described above, two pile-supported boat ramps would 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 would not be submerged completely because the gate frames rise above the gates and would be visible under most water stages. During large flood events, the sheet pile wall would be over-topped, but all in-channel structures would be designed to withstand over-topping during such events. The gates would be open during flood events and would 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 would 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 would provide:

- Information for efficient Project gate operation decisions.
- Data to test hypotheses and which should 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 the 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 B. The plan incorporates several special studies (and associated monitoring) required to examine the physical process and delta smelt response concepts underlying project design (see attachments to Appendix B).

In order to understand the effects of 2-Gates Project operations on hydrodynamic processes, a network of fixed-site sampling stations would be placed at key locations throughout the Delta (Appendix B). These stations either coincide with or would augment the network of existing Delta monitoring stations (Figure 2-13, Table 2-5). These stations would monitor fluctiions of water quality constituents over time in response to Project operations such as turbidity, salinity, and chlorophyll (Chl-a). Flow will be measrured at the same locations. These data would show how Project operations alters exchanges between regions in the Delta through these key channels.

These above special studies would 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 B). This larger program is currently being developed in collaboration with regulatory agency representatives (e.g., NMFS and USFWS) and system monitoring entities, such as the Interagency Ecological Program (IEP). 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 would provide the ability to expand sampling while not increasing take of listed species. The system is ready for field testing this spring and would be incorporated into the monitoring program for the 2-Gates project as appropriate. This comprehensive monitoring program would include:

- Identification of key potential Project impacts on other species that would be addressed by the Monitoring Program.

- Expansion of acoustic tag based investigations of 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 of the Delta 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 would 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 about how the Delta. Further details [ROS11]on the experimental design and analytical approach are provided in the Science and Monitoring Plan (Appendix B)

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 (see Table 2-5 and Figure 2-13). The stations are maintained by DWR, USGS, and Reclamation. Five new sites would be added including one on the San Joaquin River at Oulton Point, and sites at either side of each gate (see Figure 2-13).

ELECTRICAL CONDUCTIVITY

Electrical conductivity (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 (see Table 2-5 and Figure 2-13). The stations are maintained by DWR, USGS, and

Reclamation. EC would be added to the existing Victoria Canal site and to five new sites as noted in the Hydrodynamics paragraph 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 (see Table 2-5 and Figure 2-13). The stations are maintained by DWR, USGS, and Reclamation. Turbidity would be added to eleven existing stations and to the five new sites as noted in the Hydrodynamics paragraph above (see Table 2-5).

WATER TEMPERATURE

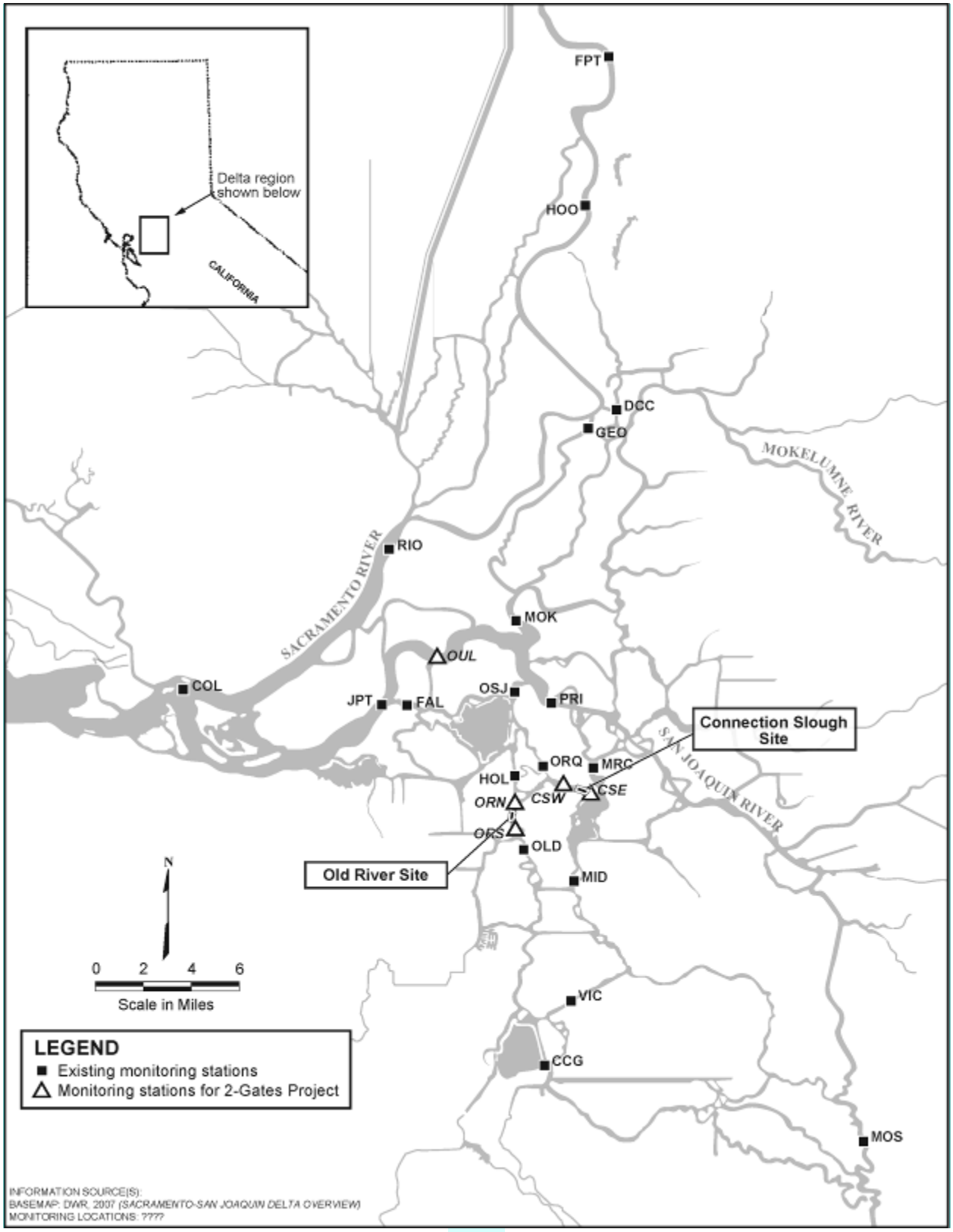
Water temperature in the Sacramento and San Joaquin Delta is monitored at five existing sites in the Central Delta (see Table 2-5 and Figure 2-13). The stations are maintained by USGS and Reclamation. Water temperature would be added to eight existing stations and to the five new sites as noted in the Hydrodynamics paragraph above (see Table 2-5).

DISSOLVED OXYGEN

Dissolved Oxygen in the Sacramento and San Joaquin Delta is monitored at one existing site in the Victoria Canal (see Table 2-5 and Figure 2-13). This station is maintained by USGS. Dissolved Oxygen would be added to twelve existing stations and to the five new sites as noted in the Hydrodynamics paragraph discussed above (see Table 2-5).

CHLOROPHYLL-A

Chlorophyll-a in the Sacramento and San Joaquin Delta is monitored at one existing site at the San Joaquin River at Mossdale (see Table 2-5 and Figure 2-13). This station is maintained by DWR. Chlorophyll-a would be added to twelve existing stations and to the five new sites as noted in the Hydrodynamics paragraph above (see Table 2-5).



[TLT12]

Figure 2-13 Locations of Existing DWR, Reclamation, and USGS Monitoring Stations in the Delta and Stations Added for the Project

Table 2-5 Existing and New Monitoring Stations and Parameters Supporting Operations of the 2-Gates Project [TLT13]

	Owner			Parameter Measured					
	USBR	DWR	USGS	Flow	Electrical Conductivity	Turbidity	Water Temp	Dissolved Oxygen	Chlorophyll -a
Locations of Existing Monitoring Stations									
Sacramento River at Freeport (FPT)		•		E		E			
Sacramento River at Hood (HOO)		•	•	E	E	E			
Delta Cross Channel (DCC)			•	E	E				
Georgiana Slough (GEO)			•	E					
Sacramento River at Rio Vista (RIO)			•	E	E				
Sacramento River at Collinsville (COL)	•		•	E	E	N	N	N	N
San Joaquin River at Mossdale (MOS)		•		E	E	N	N	N	E
San Joaquin River at Prisoners Point (PRI)	•		•	E	E	E	E	N	N
San Joaquin River at Jersey Point (JPT)		•	•	E	E	E	N	N	N
Mokelumne River at Andrus Island (MOK)			•	E					
Middle River at Columbia Cut (MRC)			•	E	E	N	N	N	N
Middle River at Bacon Island (MID)		•	•	E	E	N	N	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
False River (FAL)			•	E	E	N	E	N	N
Holland Cut (HOL)			•	E	E	N	E	N	N
Victoria Canal (VIC)			•	E	N	N	N	E	N
Clifton Court Gates (CCG)			•	E	E	N	N	N	N
Locations of 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

Note: "E" refers to existing monitoring activity; "N" refers to new monitoring activity added for 2-Gates Project.

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 2-14). Presence of adult delta smelt at these stations would indicate higher risk of potential entrainment. DFG's existing program monitors smelt monthly, beginning in February or March depending on conditions. The 2-Gates Project would 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 would require sampling twice a month beginning in March.

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

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 2-15). 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 would support additional acoustic tagging and remote recording sites on either side of each gate to better evaluate how salmon and steelhead move passed 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, acoustically tag the fish and release them in the project vicinity. This would 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.

Stationary Trawl Study

As described in Appendix B (Science and 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 would be monitored while fish sampling is conducted over a complete tidal cycle (about 12 hours) at two locations. Tidal currents would 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 would 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 would 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 would collect time series of river discharge and velocity (either depth or laterally averaged), as well as EC, temperature, salinity, and turbidity of the water at each sampling location. Fish sampling would use either the Kodiak trawl system or the mid-water trawl net. Fish sampling would occur on an hourly schedule, and all captured delta smelt would 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 POD studies (Bennett et al. 2008). Additional details regarding this study are included in Attachment B to the Science and Monitoring Plan (Appendix B).

2.5.1 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 would be tested through a specific enhancement of water quality and hydrodynamics monitoring that would 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.

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 River, 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 B [ROS14] in Appendix B. As described above, additional sensors for salt and/or Chl-a would be added to existing water quality monitoring stations to provide data for calculating fluxes.

Fish Passage and Predation

SONIC CAMERAS (DIDSON CAMERAS)

Sonic cameras (DIDSON cameras) would 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 would be fixed or boat mounted and pre-set to detect target species in designated depth ranges and sizes. The boat mounted DIDSON camera would be operated at established monitoring points used to repetitively monitor conditions on both sides of each gate (see Figures 2-16 and 2-17). Monitoring sites would include near-gate sites and sites in other locations in the channel without a gate structure. The boat mounted DIDSON camera would also be used to investigate changes in fish distribution during times when the gate is opened or closed. DIDSON cameras would 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.

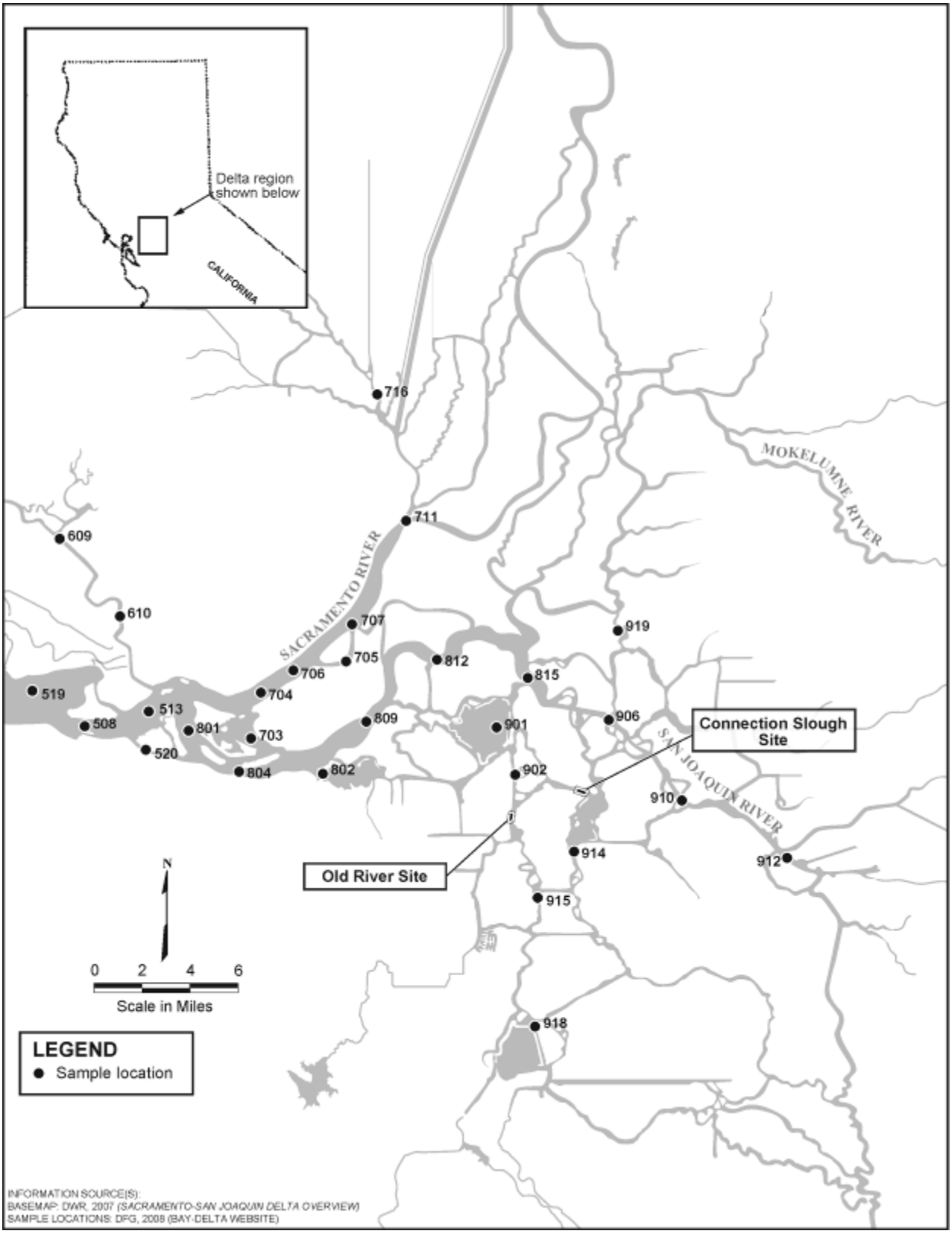


Figure 2-14 IEP Interior Delta Monitoring Stations for Fisheries Surveys

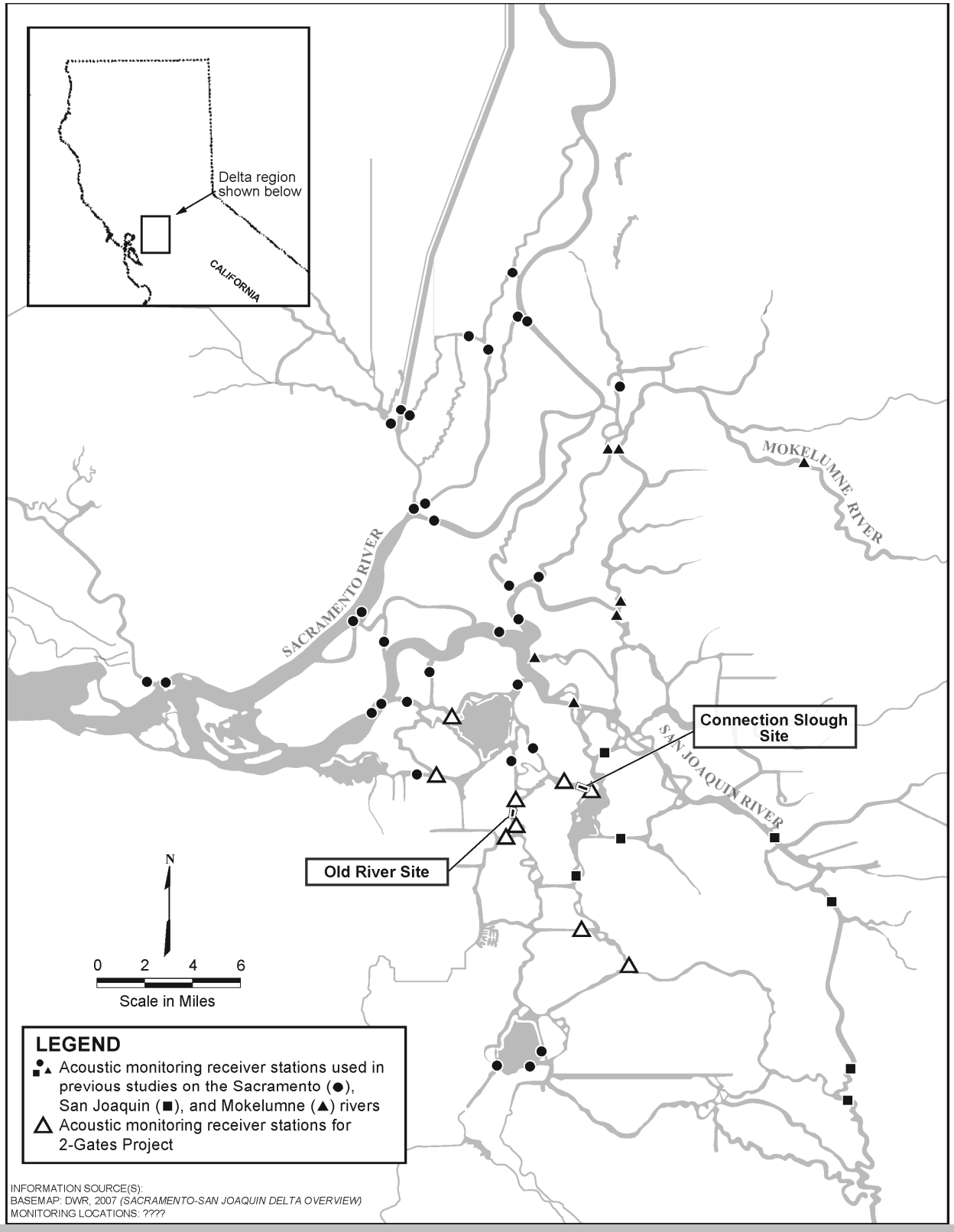


Figure 2-15 **Integration of 2-Gates Monitoring with other Potential Salmon Outmigration Studies Using Acoustic Tagging Methods (Sacramento, Mokelumne, and San Joaquin River (VAMP)**

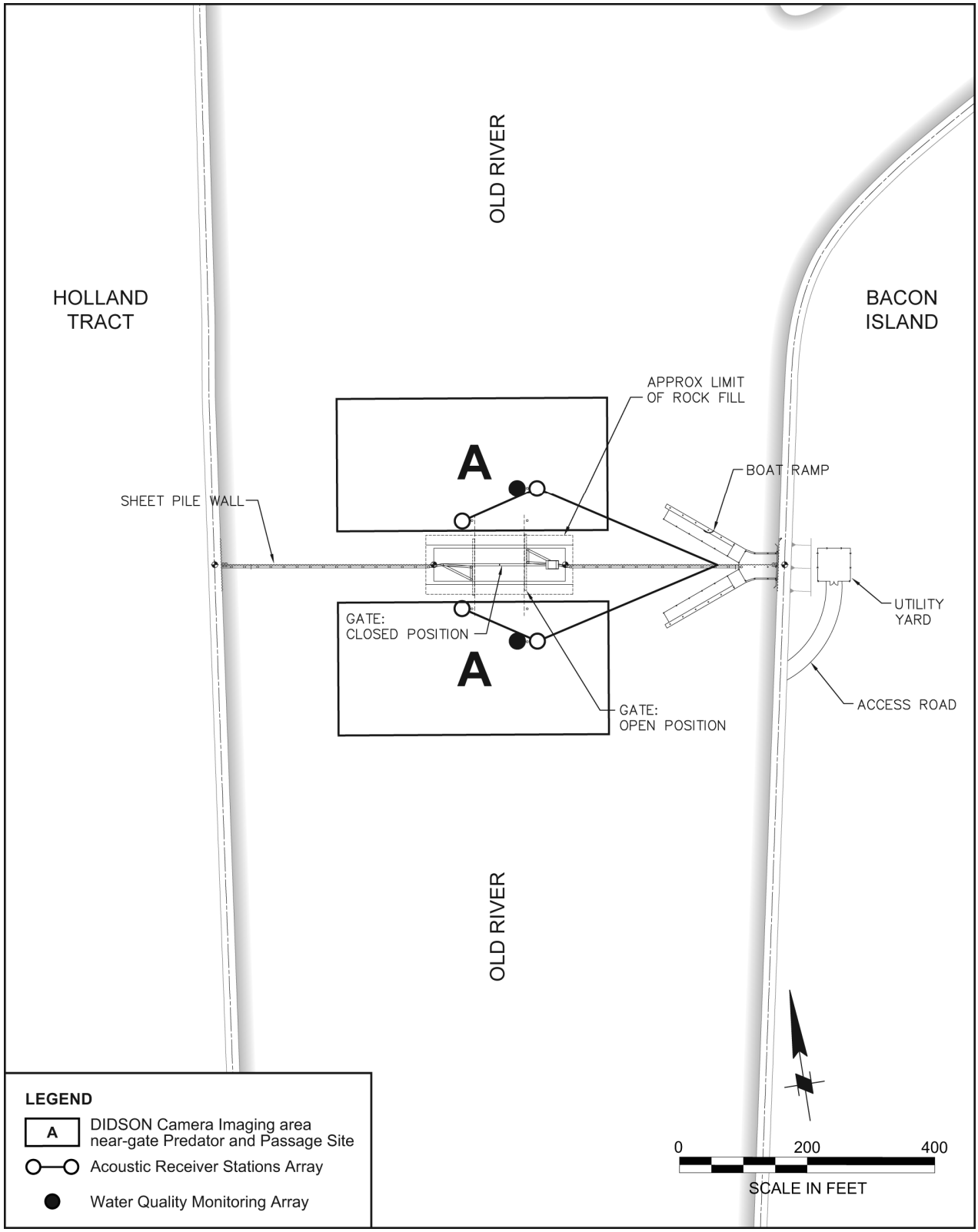


Figure 2-16 Monitoring at the Old River Gate Location for Predators, Fish Passage, Salmon Migration and Water Quality

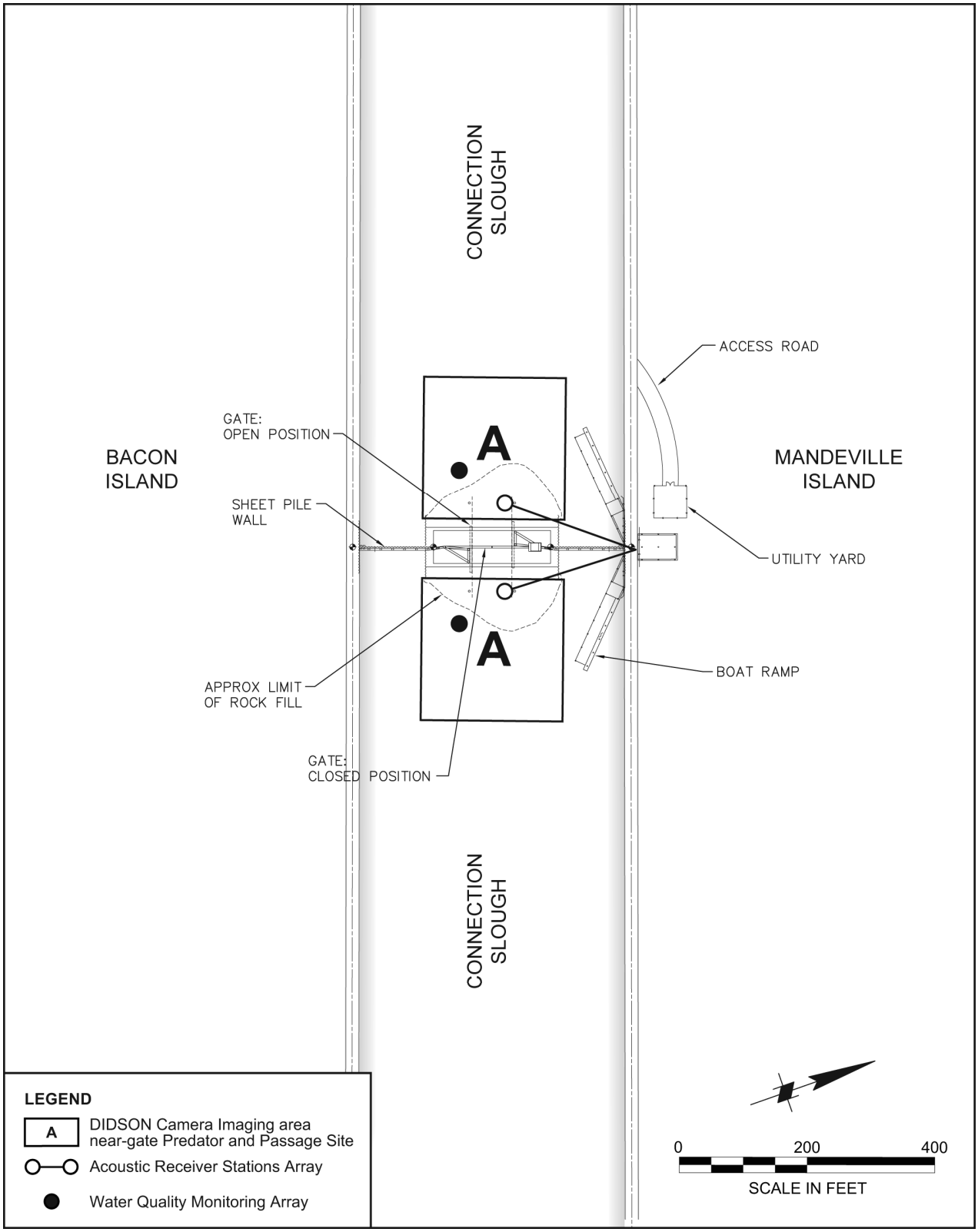


Figure 2-17 Monitoring at the Connection Slough Gate Location for Predators and Fish Passage, Salmon Migration and Water Quality

PREDATOR REMOVAL STOP HERE

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 in Table 2-6. 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 preator 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.

If the Team decides that the predation risk warrants control of the predators, methods used to reduce predator will be agreed upon and implemented. Potential methods used to reduce predator populations include boat electrofishing seines, angling or large mesh gill nets will be employed to remove predator fish such as striped bass, largemouth bass or catfish from the area near the gates.

Table 2-6 Protocols for Determining Potential Predation Risk at Two Gates Sites (Table in Development).

Location	Evaluation Factors	Old River Site High Value Site	Connection Slough Site Low Value Site
Predator Species	Striped Bass Largemouth Catfish		
Relative Density	= > or < in control sites		
Prey	Delta smelt Adults/juvs Salmon juv		
Density	High Med Low		
Time of Year	Dec-March April-May		

2.5.2 Data Collection and Distribution

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

All data would be carefully entered and stored in specifically designed Access databases. These databases would include both existing agency databases and a new 2-Gates monitoring team database. Data would be pulled from agency databases and the 2-Gates monitoring team database by the 2-Gates analysis and synthesis team (Figure 2-18).

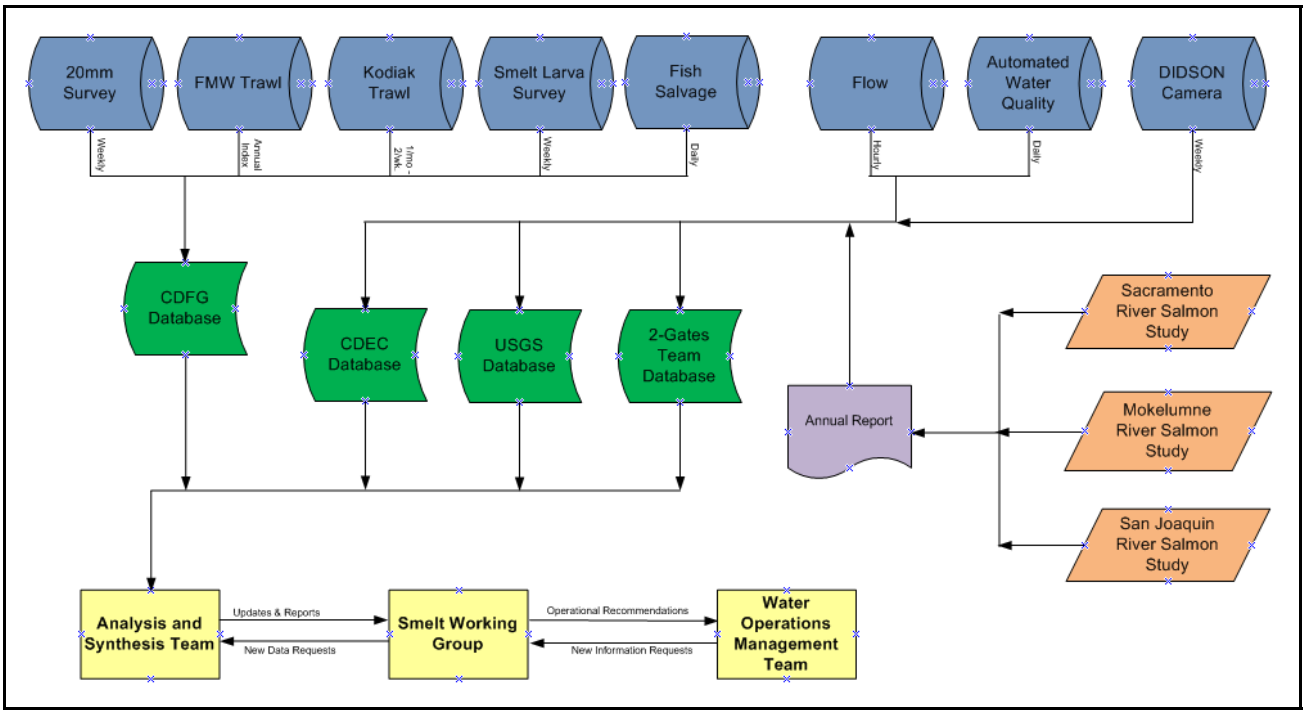


Figure 2-18 Proposed Information Management Structure for the 2-Gates Monitoring Program

2.5.2.1 Quality Assurance/Quality Control

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

2.5.2.2 Analyses Framework

Monitoring results would be utilized to drive an adaptive management feedback loop in which the Project team and agency representatives would analyze the data that is collected, communicate the results, and make decisions to adapt operations and monitoring. Key elements that would 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 memorandums, as well as monthly reports, would 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 would provide operational recommendations to the WOMT. The WOMT would 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 2-18).

2.5.2.3 Products and Disposition of Results

Deliverables would 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 would 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. Under a follow-on assignment, report sections may be developed and submitted for peer-reviewed publications to broadly disseminate the findings of the 2-Gates monitoring team, so other Central Valley projects may benefit from lessons learned here.

2.5.2.4 Feedback to Project Team

The SWG and the WOMT would 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 would make annual assessments of whether Project monitoring protocols were 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 would be essential to the success of the monitoring program.

2.6 2-GATES OPERATIONS IN CONJUNCTION WITH OCAP BO FLOW MANAGEMENT [ROS15]

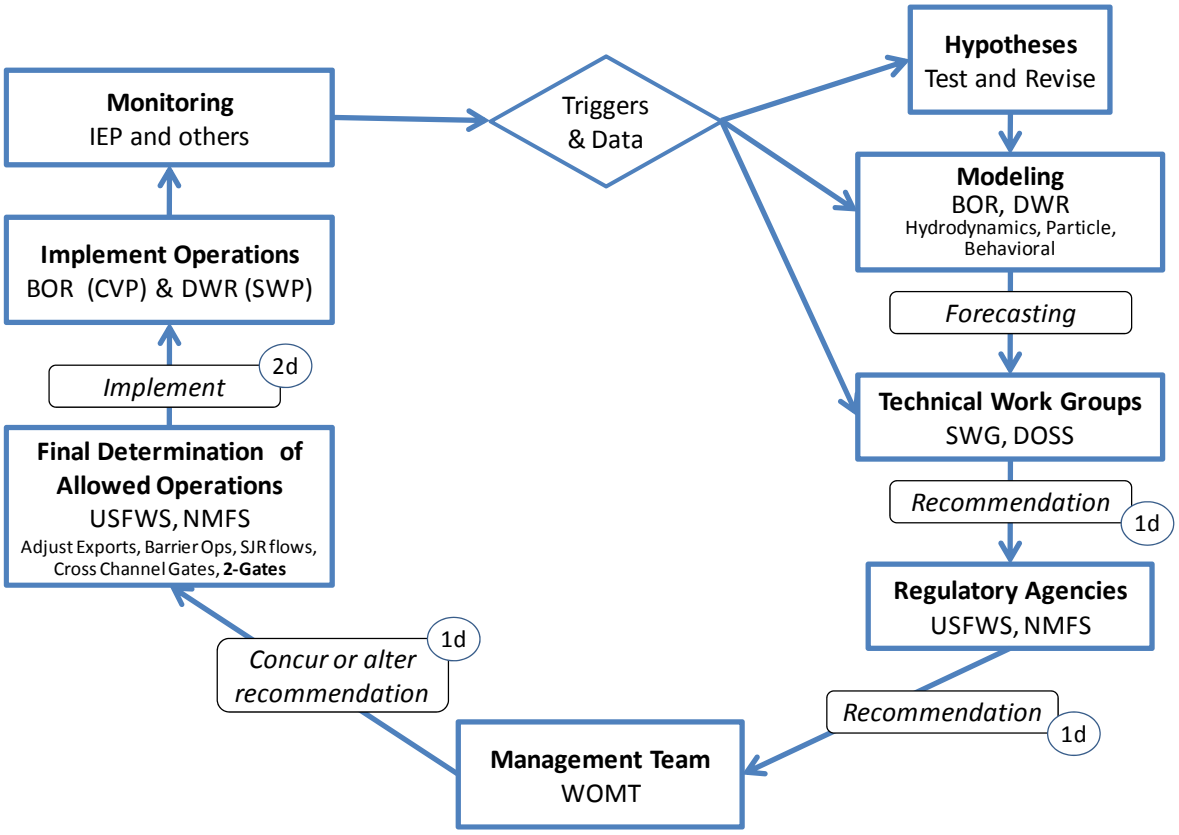
2-Gates operations will be conducted in conjunction and coordination with the OCAP BO Old and Middle River RPAs. Flow, salinity, turbidity, and particle forecasting simulations will be performed to forecast timing of the Old River and Connection Slough gate operations consistent with the RPAs. OMR flows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

2.7 ADAPTIVE PROCESS FOR DECISION-MAKING

Reclamation, or its designee, would maintain and operate the Project facilities (e.g., gates, small boat portage ramps) in a manner that is consistent with operations of the OMR flow restrictions under the OCAP RPAs. Information from the hydrodynamic and behavioral models would be provided to Reclamation and used to optimize the timing and duration of gate operations.

Decisions would be made via an adaptive process (Figure 2-19). Under the USFWS OCAP BO, the SWG meets to consider fish distribution and relative abundance in light of Delta conditions and makes recommendations to USFWS. USFWS 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 makes the ultimate decision. The 2-Gates Project operations would fit into this adaptive process, providing a new management tool (gate operations) and additional data for the regulatory agencies' decisions.

The Project operations would fit into this adaptive process, providing a new management tool (gate operations) and additional data for the regulatory agencies' decisions. The decision-making process and the Project's role within it are discussed further in the Operations Plan (Appendix D).



2.8 PROJECT MAINTENANCE

Project facilities would require limited maintenance, which would include:

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

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

2.9 FACILITIES REMOVAL

At the end of the five-year demonstration period, the barges and all associated facilities would be deballasted and removed from the Project sites. Rock fill would 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, would be removed. The removal process would take approximately four weeks.

2.10 SITE RESTORATION

Disturbed areas would be restored after initial construction and after Project structures were removed, including construction laydown areas, land-based utility yards, and pile-supported boat ramps. Restoration activities would 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 would be used only during the associated land-based construction/removal periods. The affected areas would be restored to meet local land use and resource agency requirements as soon as they were no longer needed. The pile-supported boat ramps would be removed as soon as they are no longer necessary, and the area below these decks also would be restored to meet local land use and resource agency permit conditions.

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

2.11 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.

2.11.1 Avoidance of Sensitive Resources

Qualified 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 measures also would 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 would be coordinated through a specialist familiar with the species involved. The locations of all sensitive biological (and cultural) resources and the methods to avoid them would be included in the construction drawings.

2.11.2 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 adverse effects to resident and anadromous species. Measures to minimize or avoid adverse effects on aquatic species are included in this MND/EA. 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 MND/EA. The lead agencies would comply with the RPAs or other actions required by these regulatory agencies.

2.11.3 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 would occur. Areas along the levees that are cleared prior to construction or where materials would be stored may disturb soil and vegetation and expose sites to possible erosion. Best Management Practices (BMPs) would 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 (CVRWQCB), would be developed to prevent or minimize soil erosion and protect against storm water runoff. In addition, the contractor would 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 would 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 on water quality and aquatic species from in-channel construction:

- The dikes on either side of the barge that supports the operable gates would be constructed of sheet piles instead of rock. This would 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.

2.11.4 Turbidity Criteria

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

- The Project contractor would 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 would not exceed 1 NTU.
  - Where natural turbidity is between 5 and 50 NTUs, increases would not exceed 20 percent. Where natural turbidity is between 50 and 100 NTUs, increase would not exceed 10 NTU.
  - Where natural turbidity is greater than 100 NTUs, increases would not exceed 10 percent. These limits would 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 would be protected. Turbidity would be monitored by taking grab samples for analysis of NTU levels twice per day during the work period.

2.12 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 this MND/EA and would be implemented as part of the Project.

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) and (b) will be applied if land-based construction occurs during the active season for GGS:

(a) All land-based site disturbance, including gate construction and removal, shall be conducted during the active season for GGS, between May 1 and September 30, when the snakes are active and the risk of direct mortality is lessened. Before any ground-disturbing construction activities begin, a USFWS-approved biologist shall conduct focused surveys for this species on the Project site. At a minimum a visual preconstruction survey shall be conducted not more than 24 hours before the start of construction in any portion of the Project site slated for ground-disturbing activities. Focused surveys must be conducted every year in which Project construction activities or land-based disturbance occurs.

Construction related activities may require daily monitoring during the active season for GGS. If this is deemed necessary, 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.

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

(b) 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. The fence shall be installed during the active season, May 1 to September 30, to avoid potential impacts to snakes using underground upland retreats. 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.

Mitigation measures (c) and (d) will be applied if land-based construction occurs during the dormant season for GGS:

(c) 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.

A qualified biologist in possession of a recovery permit for GGS will conduct a preconstruction survey of the site and shall monitor all initial site disturbance, 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 GGS. The biologist shall monitor all initial site disturbance 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.

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 its own accord, the permitted biologist shall capture and protect the snake in 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.

(d) If required by the DFG and USFWS, compensation for loss of upland habitat may 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 or preserved habitat will be determined through consultation with the DFG and USFWS.

Mitigation measures (e) through (i) will be applied regardless of the timing of construction activities.

(e) Before construction and prior to removal, a worker environmental training awareness program shall be conducted by 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.

(f) 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.

(g) 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.

(h) 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 with plant species that were removed during construction and removal activities.

(i) Before construction, the Project Proponent shall obtain the required permits from USFWS and DFG allowing work to be conducted in potential GGS habitat. Any additional required mitigation and minimization measures shall be implemented in accordance with the permit terms and conditions. These may include additional surveys or monitoring, changes to the timing of construction, habitat enhancement or creation, habitat acquisition, and/or the purchase of mitigation credits.

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

(a) Not more than 48 hours prior to the start of site disturbance, a qualified biologist familiar with western pond turtle 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 turtles 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 biologist6 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.

[6] 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, emergent juvenile and dispersal stages).

(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.

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.

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 et al 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.

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:

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.

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.

(d) 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. .

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.

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.

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 shall 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.

2.13 ALTERNATIVES CONSIDERED

The 2-Gates Project analyzed in this MND/EA was developed after extensive consideration of other alternatives, including other barrier alternatives and placing barriers at other locations. A number of alternative design features also were considered in order to develop a plan that minimized environmental impacts to the extent feasible.

2.13.1 Other Barrier Alternatives

A One-Dimensional (1D) DSM2 model formulation for hydrodynamic, water quality, and particle tracking initially was used to determine the most favorable location of the gates, their region of control, and their benefits under OCAP-modified flow conditions. Additionally, a Two-Dimensional (2D) RMA formulation was used to develop a reasonably accurate behavioral model to characterize both the adult and larvae/juvenile delta smelt behavior. These 2D behavioral models were used to determine effects of the 2-Gates Project for environmental documentation purposes under OCAP-adjusted hydrodynamic conditions. [sb16]

The above 1D and 2D studies used the most recent historic DSM2 simulation available from the DWR for analyses of 2-Gates and flow control measures. DSM2 analysis evaluated hydrodynamics, fate and transport of neutrally buoyant particles for OCAP BO and 2-Gates scenarios in comparison with the historic conditions; and provided technical analyses of alternatives that provide equal or better protection of delta smelt at reduced water cost compared to OCAP conditions. DSM2 simulates riverine systems, calculates stages, flows, velocities, and particle transport; and simulates many mass transport processes, including salts, temperature, and THM formation.

DSM2 particle tracking component analyses of 34 individual and combined gate alternatives in the Central and South Delta were the basis of determining the optimum locations and number of gates. Installing two gates on the Old River near Bacon Island and on Connection Slough was found to provide optimum protection to delta smelt, while reducing water export cuts under OCAP operations. DSM2 analyses determined that other individual or combined gate alternatives provided less favorable water supply and fish protective benefits, channel capacity and geotechnical conditions, including: (1) two-gates on Old River at Quimby Island; (2) three-gates at Connection Slough, Railroad Cut, and Old River below Woodward; (3) four-gates on Connection Slough, Woodward and Railroad Cuts, and Old River below Woodward; (4) selective weir removal on Paradise Cut; (5) a weir on the San Joaquin River downstream of the head of Old River; and (6) Clifton Court Forebay gate tidal re-operations. Additional information regarding hydrodynamic modeling analyses for Project site selection, Project performance, and Project development is included in Appendices E and F.

2.13.2 Design Considerations and Site-Specific Alternatives

Study areas at Old River and Connection Slough were initially established as a basis for evaluating specific gate locations. Both the Old River and Connection Slough study areas were approximately 2,000 feet in length. The study areas along Old River and Connection Slough were selected so that a gate across these portions of the river could effectively preclude sensitive aquatic species from moving toward the south Delta where DWR and Reclamation operate their export pumps. Selecting study areas north or south of the chosen Old River or Connection Slough study areas would result in less favorable soil conditions and require that several reaches of river be gated to effectively achieve the same objective. This would result in a much greater construction footprint impact, additional costs, and no additional fish protection benefits.

The proposed gate locations within the study areas were selected based on geotechnical, constructability, wetland, sensitive plants as well as other site considerations. A key geotechnical consideration included insuring that the sites were not located on excessively large deposits of silt and peat that would be less stable for gate construction. Bathymetry studies at Connection Slough indicated a relatively uniform man made channel configuration. Bathymetry at Old River exhibited extensive variability within the study area. The Old River bathymetry suggested that the site be selected at a location where the channel was not extensively deep to avoid deep cut and fill within the river and to find a location where the channel was relatively uniform. The location of the gate at Connection Slough needed to ensure an adequate queuing area for water vessel traffic relative to the bridge crossing from Bacon to Mandeville Islands. Additionally, the site selected at Old River minimized impacts to upland wetland areas.

Two engineering design alternatives were evaluated for the purpose of gate construction. Both options include an operable, barge-mounted gate that would be installed at the center of the water channel to block water flow when closed and tied into the adjacent levees with a connecting dike. There were two alternatives evaluated for the cutoff dike: rock and sheet pile. The rock dike option would place large rock between the barge located in the center of the channel to the levees on either side of the barge. The sheet pile dike option would use standard steel sheet piles driven into the channel soils to tie the barge located in the center of the channel to the adjacent levees on each side of the barge. Either dike option would utilize operable gates that can be opened as required to protect sensitive aquatic species and to afford vessel passage.

Use of the sheet piles offers the following benefits:

- No dredging of soft peat where sheets would be required. Underwater soft peat soils must be dredged before rocks can be placed or rock would be placed on top of the peat, which creates a marginally stable foundation for the rack.
- Sheet piles would minimally affect existing adjacent levees. The heavy weight of rocks could result in impacts to existing levees since the weight of the rock could result in levee instability. Use of rock gates could result in greater potential for levee failure and flood impacts. The engineering design has indicated that sheet piles would need to be installed within the adjacent levees for approximately 50 feet on either side of the gate to buttress the levees.
- Sheet piles provide a much more reliable barrier than rocks given their impact to the supporting foundation soils is minimal, and unlike rock, once installed they would not settle and deform. Once installed sheet piles would be certain to function as designed, whereas rock barriers may require continuous “dressing” to replace rock as it settles into the foundation soils.
- Sheet piles may be removed with less disruption to the aquatic environment as compared to using rocks.
- Sheet piles are less attractive to fish predators than rock. Predator fish are able to hide within rock barriers. Use of sheets reduces hiding locations for predator fish and this in turn reduces impacts to sensitive fish that may still tend to move towards the gates.

The 2-Gates Project has selected sheet pile dikes as the preferred engineering design.

The 2-Gates Project is to be implemented as soon as possible to provide additional protection to delta smelt. Given the time needed to process environmental documents and permits as well as secure required equipment, it is anticipated that the Project could be implemented as early as the fall of 2009.

The 2-Gates Project provides the most effective tool to manage delta smelt distribution to reduce entrainment by the export pumps. While 4-Gate plans were considered, those proposals resulted in greater environmental impacts and would take considerably more time to construct and therefore did not meet the Project purpose and need. The 2-Gates Project, consisting of barrier-gate systems on Old River between Holland Tract and Bacon Island and at the east end of Connection Slough, was considered relative to a variety of other gate locations and operating

plans and was selected based on an expected lowering of delta smelt related impacts compared to any other alternative.

2.13.3 No Action Alternative

This alternative would continue SWP and CVP pumping operations under current conditions including the controls listed in the RPAs in the recent OCAP BO. No additional protection would be available through structural means for protecting delta smelt. Water quality in the Delta would continue to be degraded by low pumping levels and water supplies could continue to be restricted. This alternative was carried forward for detailed evaluation in compliance with NEPA requirements, although it does not meet the Project objectives.