SECTION 2 Description of the Proposed Action and Alternatives

2.1 INTRODUCTION

2.1.1 Proposed Action Overview

develop information to determine if

The Proposed Action is intended to provide temporary, cost-effective, and 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.

With a temporary Gate structure

Can be provided

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. 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 proposed 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 USFWS and NMFS CVP/SWP Operations BOs (USFWS 2008b, NMFS 2009a) (Appendix B).

exports

only looked at 2005

Entrainment reduction may be accomplished by controlling the distribution and continuity of turbidity and salinity conditions that have been identified in the USFWS CVP/SWP Operations 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 B) suggest that operation of the Proposed Action in concert with OMR flow restrictions (USFWS 2008b) could modify the the distribution and density of adults to reduce the potential for entrainment by 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-

[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.

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 Proposed Action also may increase dispersive mixing of water in the central or southern Delta seaward toward the western Delta. This has the potential to (1) disperse larval/juvenile smelt spawned in the central and southern Delta away from the export pumps, thereby reducing entrainment risk; (2) transport juvenile smelt westward toward rearing habitat near Suisun Bay; and (3) enhance export of nutrients and phytoplankton to the west Delta. These actions would benefit the species by reducing entrainment of pre-spawning adults. The Proposed Action benefits may provide operators the flexibility for the OMR flows to operate at above the minimum values specified in the CVP/SWP Operations BOs (USFWS 2008b, NMFS 2009a).

The Proposed Action is designed to have the operational flexibility to test alternative water management and fish protection strategies. It includes a monitoring component that is intended to verify that operable gates can control water quality factors, such as turbidity and salinity. Monitoring data would be used to guide real-time operation of the gates, verify the model predictions, evaluate effects of the Proposed Action on delta smelt and other affected aquatic species, and modify operational procedures as needed (the complete Science and Monitoring Plan is included in Appendix C). 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 Proposed Action

The purpose of the Proposed Action is to test if two operable barriers placed in Old River and Connection Slough can assist in the management of delta smelt by the CVP and SWP export facilities and, once accepted, to allow for an increased ability to deliver water within the existing operational parameters. The Proposed Action proposes to add a new hydrodynamic and water quality control management tool for reducing entrainment of delta smelt by the SWP and CVP export facilities to those currently available to water and resource management agencies. 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 exceeding the protection goals established by the SWP/CVP Operations BO for delta smelt (USFWS 2008b), while (1) allowing OMR flows to exceed the minimum levels allowed by the RPA described in the BO (by some undefined amount) and (2) complying with other water management requirements (e.g., D-1485, D-1641, and the NMFS SWP/CVP Operations BO (NMFS 2009a). In particular, the Proposed Action 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 Action is designed as a demonstration project to test this premise.

The Proposed Action 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 Proposed Action. The Proposed Action 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 Proposed Action includes removal of the gate facilities at the end of the five-year demonstration period.

2.1.3 Need for the Proposed Action

The Proposed Action is needed to: 1) protect a listed species (delta smelt) from take[2]; 2) once protection is demonstrated, provide water to users within the established CVP and SWP operational parameters; and 3) test the hypothesis that the Proposed Action would meet the stated objectives of the action and enhance the knowledge of delta smelt behavior. The CVP and SWP are operated under the Operations Criteria and Plan (OCAP) and other water rights and water quality requirements. Their operations also must comply with the RPAs contained in the recent BOs for CVP/SWP Operations issued by the USFWS (2008b) and NMFS (2009a). The USFWS RPA includes actions to limit negative OMR flows to reduce entrainment of delta smelt at the CVP and SWP export facilities. The NMFS RPA also includes actions to limit negative flows to reduce entrainment of salmonids at these 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 Proposed Action Objectives

The objectives of the Proposed Action are:

- Provide cost-effective and immediate protection to delta smelt equaling or exceeding that provided by implementation of the USFWS (2008b) SWP/CVP Operations 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 (2009a) CVP/SWP Operations 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 Proposed Action 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

[2] Section 9 of the ESA provides for the prohibition of "take" of any fish or wildlife species listed as threatened or endangered under the ESA unless specifically authorized by regulation. Take, as defined by the ESA, means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in such conduct" (16 United States Code [USC] Section 1531(18)). "Harm" is further defined to include significant habitat modifications or degradation that actually kill or injure wildlife by significantly impairing behavioral patterns such as breeding, feeding, and sheltering (50 Code of Federal Regulations [CFR] Section 17.3). "Harass" is further defined to include intentional or negligent acts or omissions that create the likelihood of significant injury to wildlife through disruption of normal behavior patterns, including breeding, feeding, or sheltering (50 CFR Section 17.3). "Incidental take" is defined by the ESA as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" (50 CFR Section 17.22 and 17.32).

- Can the Proposed Action 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 Proposed Action reduce juvenile delta smelt entrainment by 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 Proposed Action performance. This knowledge would be used to refine the Proposed Action 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 are:

1. Proposed Action operations, coordinated with OMR flow restrictions, can control net flows in Old River to achieve a predictable balance of flows in between Old and Middle rivers.

2. Proposed Action 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 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 effects of the Proposed Action 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 C, Science and Monitoring Plan.

2.2 STRUCTURAL COMPONENTS

The Proposed Action involves the installation and operation of two gate structures mounted on commercially available cargo barges, one in Old River and one in Connection Slough. Plan views of the design at both the Old River and Connection Slough sites are 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 D.

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.

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 (a maximum of 24 feet and 10,000 pounds) 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. The boat ramps would not constitute a public laucnh ramp to be approached from the land; rather, they would be limited to those navigating the river channels.

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, Electrical, and other 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.

Portable restroom facilities would be provided for use by the gate operators. These would comply with Americans with Disabilities Act requirements and could be used by boaters waiting for the gates to open.

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.

Emergency Access Procedures needed somewhere

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 CONSTRUCTION PROCEDURES

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 Proposed Action 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.

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 access would be needed for construction and laydown are shown in Figure 2-3, 2-7, and 2-8. The location of 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. The location of the Roberts Island #1 disposal site, which would be used if there were not sufficient capacity at Bacon Island, is shown in Figure 2-2.

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.

What is the baseline the depth is measured from? pretty tight estimate,

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. If required to accommodate the larger dredging volumes, excess dredged material (up to approximately 40,000 cubic yards) would be barged to the Roberts Island #1 disposal site, located in the northeast portion of Roberts Island near the Port of Stockton (Figure 2-2), where it could be side-cast over the levee. This is an existing dredged materials disposal site, and prior to disposal, dredged sediment would be tested in accordance with the procedures established by the Central Valley Regional Water Quality Control Board (CVRWQCB) (CVRWQCB 2004) to determine its

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 in order to establish the maximum noise level. A bubble curtain would be used for all other pilings in greater than 1 meter water depth. Three additional piling would be driven, and underwater sound levels would be monitored at a depth of approximately 3 meters and a distance of 10 meters from the pile being driven. If sound levels do not exceed 187 dB RMS or 207 dB Peak at these locations, pile driving may proceed. If sound levels exceed 187 dB RMS or 207 dB Peak at these locations, pile driving would be restricted to the period between one hour prior to slack water and one hour following slack water.

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 both the Old River and Connection Slough sites 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 Old River and Connection Slough 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 Proposed Action, 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 Proposed Action's website (http://www.baydeltalive.com/?page=Projects&subpage=Project%20Page&view=Project%20Page&id=563).

2.3.8 Construction Schedule

The proposed 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 D.

Table 2-2 Proposed Action 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 OPERATIONS

The proposed 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 E). Gate operations would begin as early as December each year when smelt distributions are located north and west of the proposed facilities as determined by flow, turbidity, salinity, and biological data collected by monitoring.

The Proposed Action would be ~~operated~~ by Reclamation in a manner that is consistent the operations of the OMR flow restrictions under the SWP/CVP Operations RPAs (USFWS 2008b and NMFS 2009a)). Table 2-3 illustrates the timing of proposed operations and the most relevant RPA actions. The decision-making process and the Proposed Action's role within it are discussed further in Section 2.7 and the Operations Plan (Appendix E).

Table 2-3 Summary of RPA Actions[1] and Proposed Operations

Month	2-Gates	2-Gates	USFWS Action 1	USFWS Action 2	USFWS Action 3	NMFS Action IV. 2.1	NMFS Action IV. 2.3
	Pre-spawning Adult Delta Smelt entrainment protection	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 San Joaquin River 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 ≥12°C or spawning detected.		**December – March** Limit exports to limit negative OMR flows (-2,000 to -2,500 cfs), until water temperature ≥12°C or spawning detected.	**December – March** Limit exports to limit negative OMR flows (-1,250 to -5,000 cfs), until water temperature ≥12°C or spawning detected.			
Jan							**Jan 1 – June 15** OMR flow (-5,000 to -2,500 cfs) until after June 1 water temperature at Mossdale ≥ 22°C for 7 days.
Feb							
Mar		**Early/mid March – March 31** Once temperature ≥12°C or spawning detected, operate gates for dispersive mixing.			**Early/mid March - June 30** Once temperature ≥12°C 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 ≥ 25°C					

Note:
1 USFWS 2008b CVP/SWP Operations BO RPA Component 1 and NMFS 2009a SWP/CVP Operations BO RPA Action IV.2

2.4.1 Factors Considered in Proposed Action Operations

2.4.2 Gate Operation Protocols

The proposed operating plan is sufficiently flexible to adapt to real-time monitoring and predictive hydrodynamic, water quality, and delta smelt behavior modeling (Appendix E). 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).

Table 2-4 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 would be operated to balance flows and maintain a low turbidity zone in Old and Middle rivers. • Trigger for operations – turbidity ≥ 12 NTU at San Joaquin River at Jersey Point. • Off-ramp – Water temperatures ≥ 12 degrees C 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 would 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 would 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 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 (2008b) SWP/CVP Operations BO: (1) pre-spawning adult protection and (2) larval and juvenile protection. Gate operations would

~~RPAs and 2-Gate operations (lagging indicator)~~. Salvage data does provide valuable feedback for guiding gate operations and exports, testing hypotheses, and adaptive management.

because it is a lagging indicator

2.4.3.1 Operations for Adult Delta Smelt (December through March)

This section describes how the proposed gates would be operated in order to affect entrainment of adult delta smelt.

Doesn't this entire section belong in the effects analysis?

Operational Objectives:

- To provide equal or improved protection to pre-spawning adult delta smelt from entrainment by early operation of the proposed facilities and early implementation of USFWS RPA Action 1.
- 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 SWP/CVP Operations BOs (USFWS 2008b, NMFS 2009a) and all other water management requirements.

Actions:

The gates would be operated from the onset of the higher turbidity conditions in December into March in order to protect pre-spawning adult delta smelt as they migrate inland. 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 the operation of other proposed facilities.. Gates would be operated 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 E). 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[4], which are average daily OMR flow[5] no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent). Forecast model simulations would be rerun in response to real-time turbidity data as needed to detect upcoming high turbidity events.

Timing:

The adult operations would take place from December into March. Forecast modeling would begin December 1, and gate operations would begin with the first flush in December. However, the Smelt Working Group (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

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[4] 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 (USFWS 2008b).

[5] OMR flows for this and all relevant actions would 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.

successful delta smelt spawning occurs (USFWS 2008b). The water temperature threshold (≥ 12°C) signals a transition from adult to larvae/juvenile delta smelt management actions.

- **Biological: presence of spent females in SKT or salvage facilities.** These operations would be continued until water temperatures ≥12°C (3-station daily mean at Mossdale, Antioch and Rio Vista) or until hydrodynamic forecast modeling indicates that proposed 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 Proposed Action, in conjunction with OMR flow restrictions (USFWS 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.

2.4.3.2 Operations for Larvae/Juvenile Delta Smelt (March through June)

This section describes how the proposed gates would be operated in order to affect entrainment of larvae and juvenile delta smelt.

Same

Operational Objectives:

- To provide equal or improved protection of larval and juvenile delta smelt from entrainment by increasing dispersive mixing to enhance downstream transport.
- 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 SWP/CVP Operations BOs (USFWS 2008b, NMFS 2009a) and all other water management requirements.

Actions:

The gates would be operated tidally to increase dispersive mixing from the central and south Delta toward the western Delta. The Old River gate would 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 would be closed about 20 hours and open during slack tide (~ 4 hours daily). Net daily OMR flow would be no more negative than -1,250 to -5,000 cfs based on a 14-day running

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 2008b SWP/CVP Operations BO). From April 1 through May 31, the gates would 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 (2009a) SWP/CVP Operations BO (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 Proposed Action.

2.4.3.3 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 25°C or until their up-estuary migration begins in December; therefore, protection from entrainment and salvage are not needed.

2.4.3.4 Vessel Access

The lead agencies would keep the Sector Waterways Management Division (USCG Station Yerba Buena Island) informed about the Proposed Action, 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 Proposed Action, 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.

USBR + DWR OPS too

Who operates the truck + trailer?

2.4.4 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.

What would still be above water?

↳ Site appendix where water level analysis is disclosed

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 Proposed Action includes a monitoring and special studies program that would provide:

- Information for ~~efficient~~ effective gate operation decisions.
- Data to test hypotheses
- Data that should reduce uncertainties regarding delta smelt ~~responses to 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 ~~proposed~~ operations as implemented
- Data to evaluate ~~potential~~ effects of the Proposed Action on other species of interest (e.g., predation risk at gate structures, movement of salmonids and sturgeon).
- Guidance for adaptive modifications of project operations and structures.

This monitoring plan is presented in Appendix C. The plan incorporates several special studies (and associated monitoring) required to examine the physical process and delta smelt response concepts underlying project design (see attachments to Appendix C).

In order to understand the effects of proposed operations on hydrodynamic processes, a network of fixed-site sampling stations would be placed at key locations throughout the Delta (Appendix C). 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~~ collect information on fluctuations of water quality constituents ~~over time in response to proposed operations~~ such as turbidity, salinity, and chlorophyll (Chl-a). Flow would be measrured at the same locations. These data would show how proposed operations alter 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 Proposed Action effects and effectiveness, particularly in regard to potential impacts on other listed species (Appendix C). 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 impacts on other species that would be addressed by the Science and Monitoring Plan (Appendix C).
- 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 Proposed Action.
- Expansion of the principal existing adult delta smelt abundance and distribution monitoring effort, (IEP's SKT Survey), to cover the full season of adult operations and to intensify sampling in the area of the Delta affected by the Proposed Action.
- 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 proposed 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 2-Gates Project and agency staff and any other collaborators.
- Establishment of data synthesis and information dissemination infrastructures to feed adaptive management decision making regarding proposed operations. It is expected that existing decision making bodies, such as the Smelt Working Group (SMG) and Water Operations Management Team (WOMT) would be the principal recipients of monitoring information related to the Proposed Action.

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 proposed monitoring, special studies and field testing programs to draw inferences and conclusions about the effects and effectiveness of the Proposed Action and expand our knowledge about how the Delta functions. Further details on the experimental design and analytical approach are provided in the Science and Monitoring Plan (Appendix C).

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 -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).