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Abbreviations & Acronyms

AFRP	Anadromous Fish Restoration Program
AFSP	Anadromous Fish Screen Program
BA	Biological Assessment
BDCP	Bay Delta Conservation Plan
BDPAC	Bay Delta Public Advisory Committee
BO	biological opinion
CBDA	California Bay-Delta Authority
CCWD	Contra Costa Water District
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CFS	conservancy fairy shrimp
CNDDB	California Natural Diversity Database
Corps	U.S. Army Corps of Engineers
CVI	Central Valley Chinook salmon ocean harvest index
CVP	Central Valley Project
CVP	Central Valley Pumps
CVPIA	Central Valley Project Improvement Act
dB	decibels
DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin Delta
Delta	Sacramento-San Joaquin River Delta
Delta	San Joaquin Delta
DFG	Department of Fish and Game
DOI	Department of the Interior
DPSs	distinct population segments
DSM2	Delta Simulation Model II
DWR	Department of Water Resources
EFH	essential fish habitat
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
EWA	Environmental Water Account
EWP	Environmental Water Program
FMPs	fishery management plans
FMWT	Fall Midwater Trawl Survey
FRFH	Feather River Fish Hatchery
GGS	Giant Garter Snake
GGS	Giant Garter Snake
HORB	Head of Old River Barrier
IEP	Interagency Ecological Program

JPE	Juvenile Production Estimates
LSNFH	Livingston Stone National Fish Hatchery
LSZ	low salinity zone
LWD	large woody debris
mm	millimeters
NMFS	National Marine Fisheries Service
NPS	non-point source
OMR	Old and Middle Rivers
PAHs	polycyclic aromatic hydrocarbons
PCE	Primary Constituent Elements
PFMC	Pacific Fishery Management Council
POD	Pelagic Organism Decline
Project	2-Gates Project
PTM	particle tracking model
RBDD	Red Bluff Diversion Dam
RM	river mile
RMA	Resource Management Associates
RPA	Reasonable and Prudent Alternative
SDTB	South Delta Temporary Barriers
SEL	sound exposure level
SKT	Spring Kodiak Trawl
SMSCG	Suisun Marsh Salinity Control Gates
SRA	shaded riverine aquatic
SWP	State Water Project
SWP	State Water Pump
SWRCB	State Water Resources Control Board
TBI	The Bay Institute
TNS	Townet Survey
USFWS	U.S. Fish and Wildlife Service
VAMP	Vernalis Adaptive Management Plan
VPFS	vernal pool fairy shrimp
VPTS	vernal pool tadpole shrimp
WAP	Water Acquisition Program
YOY	young-of-the-year

SECTION 5

Effects of the Action

5.1 OVERVIEW

In Section 2.2, "Project Description," of this BA we provide an overview of the Action, its location, the gate concept, and planned construction, operations, and maintenance activities along with other actions incorporated to protect listed aquatic and terrestrial species within the Action Area (the area anticipated to experience direct or indirect effects of the project). Section 3.0, "Status of Species and Critical Habitat," and Section 4.0, "Environmental Baseline" provide an overview of listed aquatic and terrestrial species and designated critical habitat under consideration, along with their current status and a description of the multitude of factors already affecting listed species populations both throughout their range and within the Action Area.

The following analysis focuses on those factors that are caused, either directly or indirectly, by the 2-Gates Project. After a brief description of the analytical approach used in this BA, this effects analysis is organized first according to project phase (construction, operations, or monitoring), and second according to species groups and critical habitat (aquatic species and their critical habitat, then terrestrial species and their critical habitat).

The following effects analysis is based on our current understanding of construction and operations effects of the project. Construction effects are evaluated relative to changes to existing habitats that are already in degraded conditions at the project sites – both areas contain rip-rapped levees along both banks. Riparian habitat consists of a bed of emergent vegetation primarily tules and cattails supporting limited to little shaded riparian aquatic habitat. Connection Slough is a constructed channel. Neither channel is regularly dredged to support navigation but may be irregularly dredged to maintain or repair levees. Both sites are influenced Delta inflow, tidal flows, in-Delta use and exports by CVP and SWP operations.

The effect of 2-Gate operations is based on extensive hydrodynamic and delta smelt behavioral modeling. Details of the RMA delta smelt behavioral models are Appendix E and were present in the Forward. Initial results from the modeling processes indicates a dramatic decrease in the entrainment risk to adult and juvenile delta smelt and other species when the 2-Gates Project is operated in a comprehensive manner with OCAP flow restrictions and QWEST flows at San Andreas. Collectively, deploying and operating the 2-Gates Project can result in increased protection for delta smelt while providing for reduced restrictions on water supplies.

5.2 APPROACH TO THE OPERATIONS ASSESSMENT

The development of the 2-Gates Project employed a process of model development and use, while applying progressively detailed model analyses from the site selection through final effects analyses phases (a description of this process is included in the Forward and more complete descriptions of the models and assumptions are included in Appendix E. This section generally describes this process to evaluate effects on biological resources and present results and essential findings to support the effects analysis. A list of the model development steps is provided in the Forward

It should be pointed out that the many modeling steps used differing operational assumptions and hydrology. This was a vailid process for transitioning from one level of study to another in an effort to refine and improve project operations. What became clear during this process was that the 2-Gates Project consistenly provided better protection to delta smelt adults and juveniles compared to only controlling reverse flows on Old and Middle Rivers (OMR). The modeling effort was an iterative process where results from previous models were used to refine operations and in order to develop simulations to reflect operations to conditons that reflect realtime conditons. Because of this iterative process, model results should not be directly compared between models.

5.2.1 Model Development

Early in the analyses process, it was determined that complex delta smelt behavioral models would be useful to, with reasonable accuracy, predict distribution, abundance and fate of delta smelt under OCAP and 2-Gates operational conditions. Because the development of such a model would be time-consuming and its success could not be accurately predicted, a decision was made to initially use the One-Dimensional (1D) DSM2 model formulation for hydrodynamic, water quality and particle tracking to determine the most favorable location of gates, their region of control and their benefits under OCAP-modified flow conditions. While this effort was taking place, the RMA team developed an accurate behavioral model using a Two-Dimensional (2D) RMA formulation, as modified to characterize both the adult and larvae/juvenile delta smelt behavior. The 2D behavioral models were used to determine effects of the 2-Gates Project for environmental documentation purposes under OCAP-adjusted hydrodynamic conditions. Project operations criteria were improved based on the knowledge derived from the preceding evaluations. Therefore, the results from the initial simulation my not be precisely replicated with the Project operations. However, the Project operations incorporated the beneficial components of the initial simulations and overall Project performance improved through the development process. For example, early simulations assumed particle tracking would be a reasonable simulation of delta smelt behavior while the later simulations used more sophisticated delta smelt population distributions (from samples) and an enhanced simulation of adult delta smelt movement behavior.

One-Dimensional DSM2 Analyses

This analyses of 2-Gates flow control measures to identify the region of control and the formation of a physical/hydraulic barrier for the control of delta smelt migration into the south Delta used the most recent historic DSM2 simulation software available from the Department of Water Resources (DWR). The initial Project formulation analyses used DSM2 to (1) evaluate hydrodynamics, fate and transport of neutrally buoyant particles for historic hydrology and for simulating the operating rules contained within the OCAP BO and with operations simulating the 2-Gates Project.

INITIAL SITE SCREENING STUDY USING DSM2 ANALYSES.

Once the region of control was identified, then DSM2 PTM was used to evaluate 34 individual and combined gate location alternatives in the central and south Delta to determine the optimum locations and number of gates[1]. A 2-Gates Project on the Old River near Bacon Island and on Connection Slough provided optimum protection to delta smelt. DSM2 analyses determined that other individual or combined gate alternative locations provided less favorable fish protective benefits. Some locations were constrained by channel capacity or unfavorable geotechnical conditions. Other alternative locations studied, included: (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

[1] Release date: 2Mar03

the head of Old River; and (6) Clifton Court Forebay gate tidal re-operations. Certain of these alternatives also included combined QWEST management. Water supply options were also evaluated at this step.

One-hundred and forty (140) PTM analyses were analyzed to determine the effectiveness of 2-Gates in controlling particle entrainment at south Delta export facilities[2]. Particle insertion locations used in these analyses are shown on Figure 5-1. The Project facilities reduced particle entrainment at the pumps predominately for insertion points downstream of the gates on Franks Tract, Dutch Slough, False River, Fisherman's Cut and Old River. Reduction in entrainment was also shown for insertions on Old River between Railroad Cut and the gate. Circulation patterns developed by the Old River gate operating open on flood-tide and closed on ebb-tide, while the Connection Slough Gate remained closed, consistently promoted seaward movement of particles in Old River and away from the pumps. These findings were used to define the region of control of the gates, largely bounded by the Old River, False River, Dutch Slough and Fisherman's Cut. Table 5-1 shows the particle insertion locations, hydrologic periods of analyses and particle entrainment results for the cases modeled. The blue colored values define the region of the control of the gates operating under historical conditions. Operation of the 2-Gates facilities was also found to improve water quality conditions in the central and south Delta.

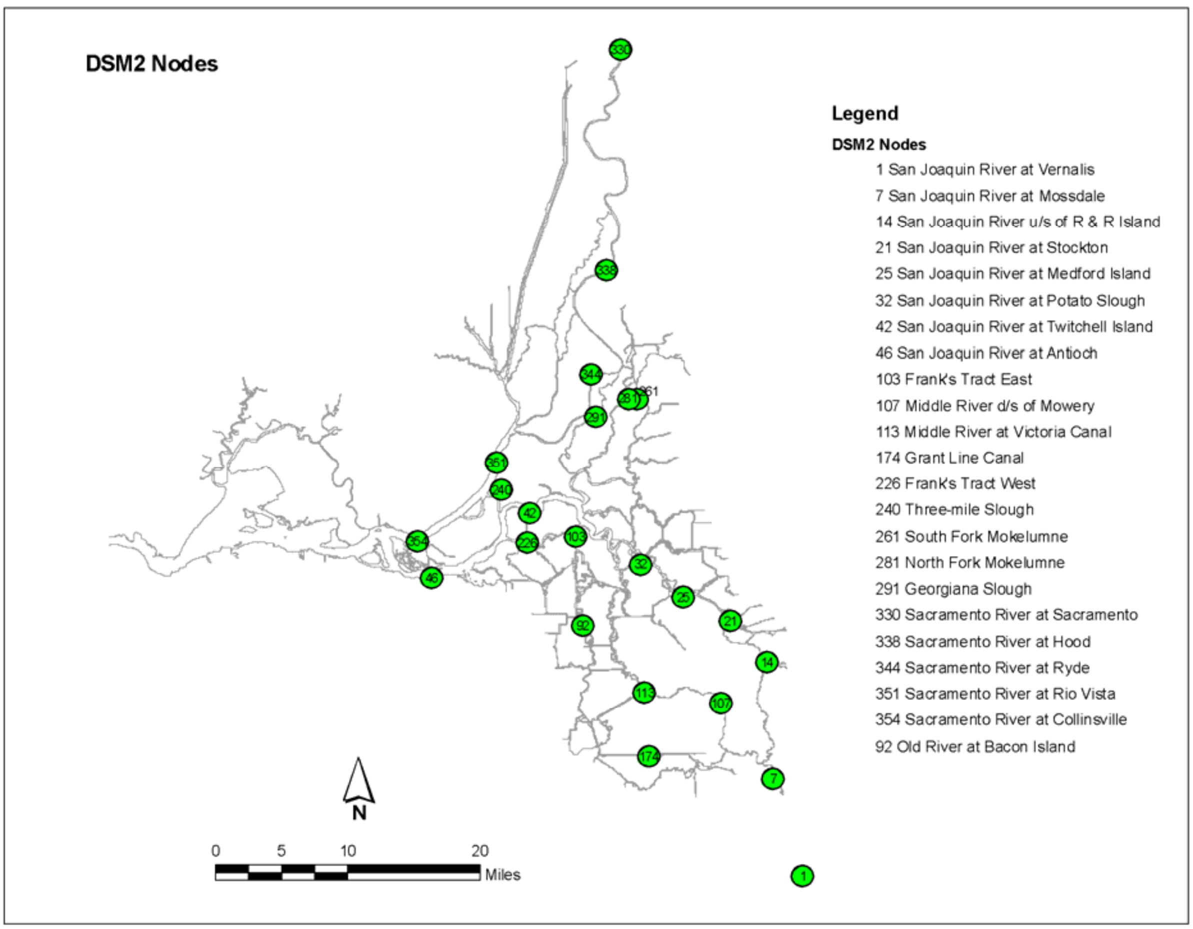

Figure 5-1 Location of DSM2 particle tracking simulation insertion points.

[2] Release dates: 1Apr91, 1Mar 01, 2Mar03, 27Mar03, 1Feb05

Table 5-1 Particle Insertion Locations and Resulting Change in Percent Particle Entrainment Compared to Historic Conditions. Red values indicate increased entrainment, blue values decreased entrainment at the pumping facilities. Blue values generally define the region of control.

No.	Location	DSM2 Node	Change in % Entrainment at Export Pumps				
			2-Mar-03	1-Apr-91	1-Mar-01	1-Feb-95	27-Mar-03
1	San Joaquin River at Vernalis	1	6	12	8	4	7
2	San Joaquin River at Mossdale	7	7	16	9	3	8
3	San Joaquin River at Stockton	21	-7	-13	-4	9	1
4	San Joaquin River at Empire Tract	25	-6	-6	3	6	-2
5	San Joaquin River at Rindge Pump	32	-4	-3	-5	8	2
6	San Joaquin River at Twitchell Island	42	14	17	6	-1	18
7	San Joaquin River at Antioch	46	0	-1	-1	0	-2
8	Old River at Bacon Island	92	-84	-80	-97	1	-90
9	Frank's Tract East	103	-51	-47	-53	-3	-58
10	Frank's Tract West	226	-11	-13	-12	-5	-14
11	Middle River at Victoria Canal	113	1	-1	0	0	0
12	Three-mile Slough	240	4	1	-2	0	6
13	South Fork Mokelumne	261	9	24	21	6	10
14	North Fork Mokelumne	281	16	26	16	1	15
15	Georgiana Slough	291	12	17	19	-1	20
16	Sacramento River at Sacramento	330	3	3	4	0	3
17	Sacramento River at Hood	338	1	3	2	0	4
18	Sacramento River at Ryde	344	2	0	-1	0	0
19	Sacramento River at Rio Vista	351	-1	0	0	0	0
20	Sacramento River at Collinsville	354	0	0	0	0	0
21	Middle River at North of Mowry	107	0	4	-8	-	0
22	SJR south of Rough and Ready Island	14	-7	31	9	5	-3
23	Grant Line Canal	174	0	0	0	0	0
24	San Joaquin River downstream of Big Break	461	-1	-3	-1	0	-1
25	Old River near Quimby Island	99	-78	-83	-91	1	-87
26	Mokelumne River downstream of Cosumnes Confluence	258	6	23	17	2	11
27	Mokelumne River downstream of Georgiana Confluence	272	10	19	19	-2	19
28	Little Potato Slough	249	3	1	15	0	5

DSM2 ANALYSES FOR COMBINED 2-GATE AND QWEST STUDIES TO EVALUATE PHYSICAL/HYDRAULIC CONTROL.

DSM2 PTM analyses were conducted to determine operations of the 2-Gates together with flow management on the San Joaquin River generated through OMR restrictions during critical periods. These operations generally maintained the distributions of particles within or north/west of the region of control of the gates, forming an effective hydraulic barrier to upstream smelt movement or migration into the south Delta. Operations of the 2-Gate Project are shown to be consistent with the protective actions proposed by the U.S. Fish and Wildlife Service's OCAP BO (USFWS 2008).

The outputs of DSM2 analyses of the 2-Gate Project provide insight into how to effectively operate the gates and potential benefits from flow rate modification. In these analyses, Three-hundred and twenty (320) PTM analyses were conducted at 20 mm smelt survey locations (Figure 5-2) using DSM2 to determine operational effects of combined 2-Gates and QWEST operations. The latter studies were performed in anticipation of potential operation in conjunction with the new OCAP BO and subsequent RMA delta smelt behavioral analyses[3]. The 2-Gates Project and modest QWEST operations were found to provide an hydraulic barrier to delta smelt movement into the south Delta, and were found effective in preventing particle entrainment within in the region of control of Project and QWEST controls (Tables 5-2 and 5-3; and Figures 5-2 and 5-3):

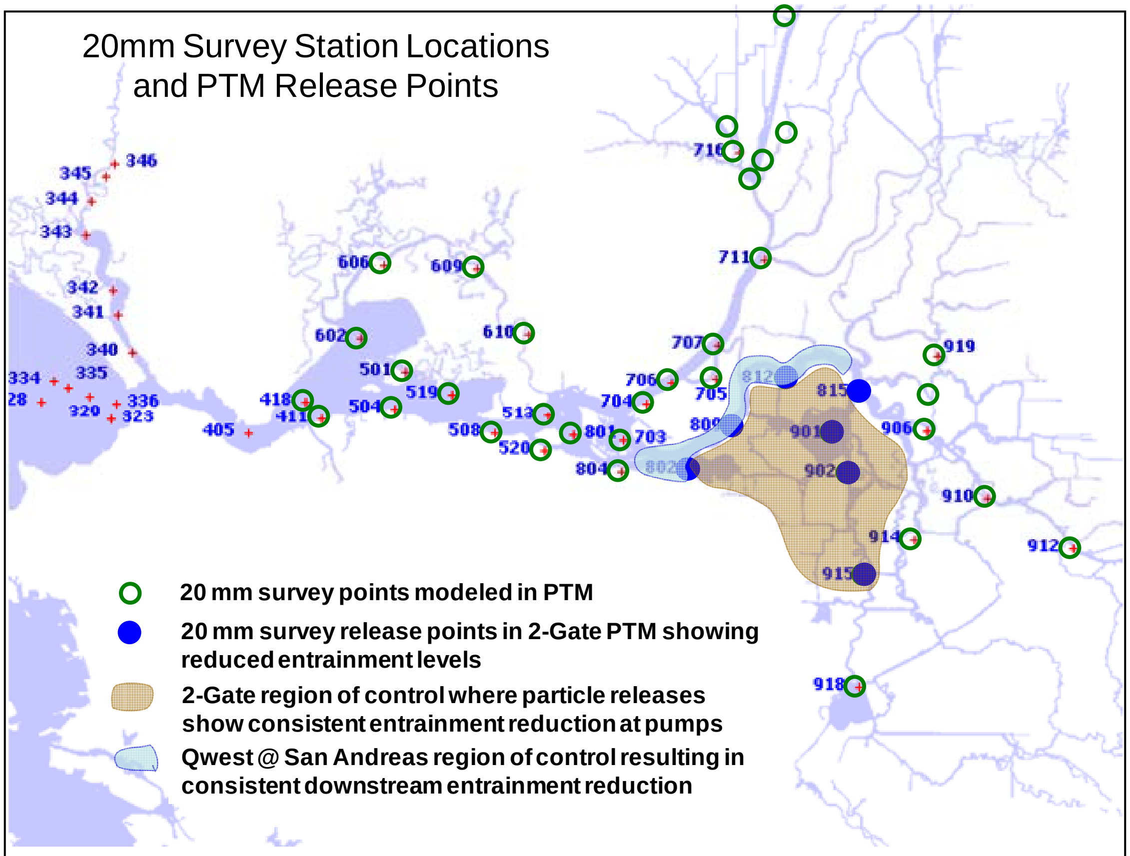

Figure 5-2 20 mm Smelt Survey, Particle Release Points and Region of Control

[3] Release dates: 9Jun99, 12Jun02, 15May02, 30May02, 21May03, 1May04, 16Dec03, 30Dec04

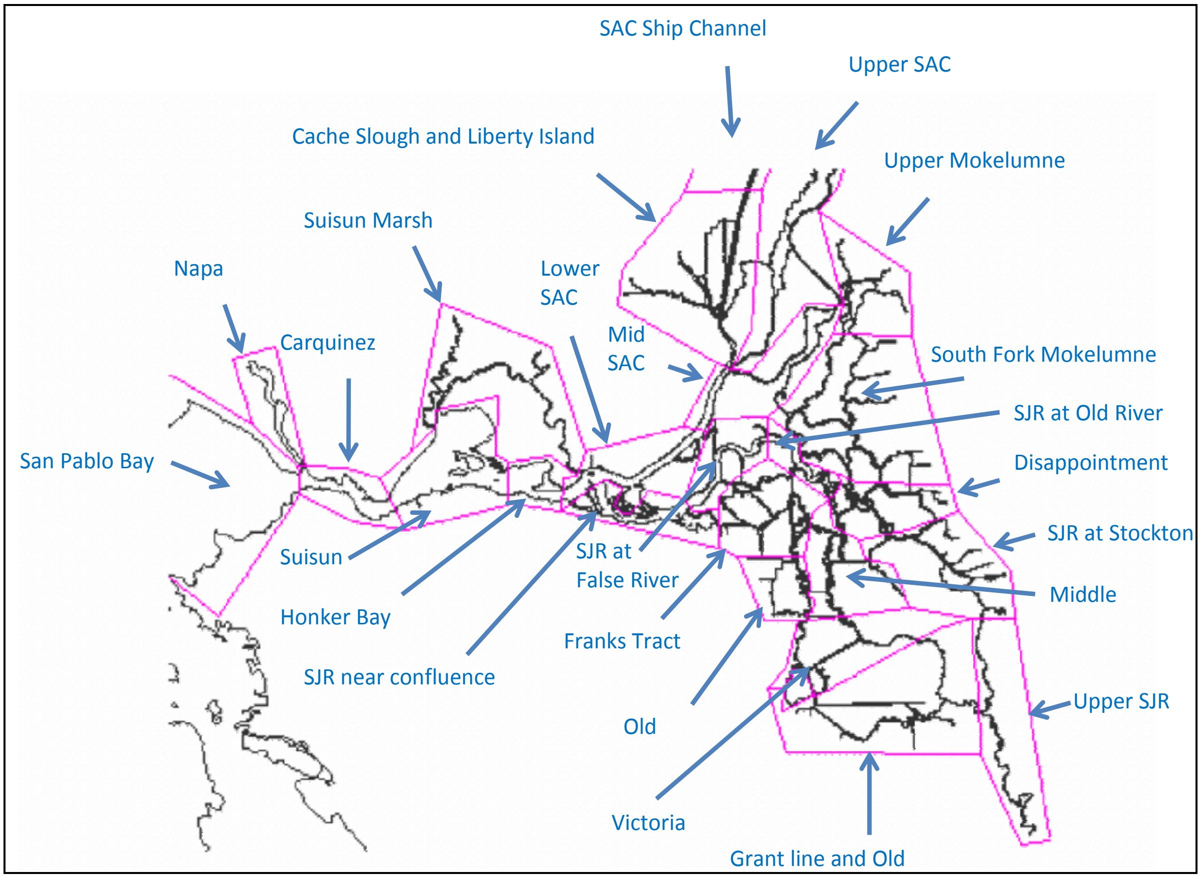

Figure 5-3 Generalized modeled regions of the Delta. The region of control includes SJR at Old River, Middle River, Victoria, Old River, Frank's Tract and Sjr at False River.

Table 5-2 Entrainment Results for Release Point #809

Survey Location /Release Point	% Entrainment from Release Location #809							
	Feb-Jun						Dec-Feb	
	9-Jun-99	12-Jun-02	15-May-02	30-May-02	21-May-03	12-May-04	16-Dec-03	30-Dec-04
Historic	2	5	0	2	2	1	29	3
Historic + 2-Gates	0	2	0	1	1	0	25	1
Historic + 2-Gates + QWEST > -1,000 cfs	1	1	0	1	0	0	9 [5]	0
Historic + 2-Gates + QWEST > 0 cfs	1	0	0	0	0	0	6 [5]	0

[5] 0% entrainment observed in Historic + 2-Gates + QWEST >-1,000 cfs, when exports were curtailed to match San Joaquin River flow during the gate closure.

Table 5-3 Entrainment Results for Release Point #902

Survey Location /Release Point	% Entrainment from Release Location #902							
	Feb-Jun						Dec-Feb	
	9-Jun-99	12-Jun-02	15-May-02	30-May-02	21-May-03	12-May-04	16-Dec-03	30-Dec-04
Historic	51	60	20	50	56	24	97	92
Historic + 2-Gates	1	2	0	1	6	1	11	4
Historic + 2-Gates + QWEST > -1,000 cfs	1	1	1	0	2	1	4 [5]	3
Historic + 2-Gates + QWEST > 0 cfs	1	0	1	0	2	1	4 [5]	3

[5] 0% entrainment observed in Historic + 2-Gates + QWEST >-1,000 cfs, when exports were curtailed to match San Joaquin River flow during the gate closure.

Further analyses were conducted to determine potential mitigating effects of combined 2-Gates and QWEST flow control measures, consistent with OCAP OMR restrictions, on Mokelumne River salmon. Tables 5-4 and 5-5 show examples of adding QWEST flows to 2-Gate Project operations to prevent substantial increases in particle entrainment or to reduce entrainment originating from the region of the confluence of the Mokelumne and San Joaquin rivers. The red symbols on Figure 5-4 depict 20mm survey location insertion sites that would otherwise be impacted without the application of such QWEST controls. Adding QWEST @ San Andreas > -1,000 cfs to 0 cfs to the 2-Gates Project operations was found to prevent increased entrainment or to reduce entrainment of particles from the Mokelumne and San Joaquin River regions in two-thirds of the model runs. Operations of the gates can also be changed (left open) with additional QWEST flow depending on severity of forecasted conditions.

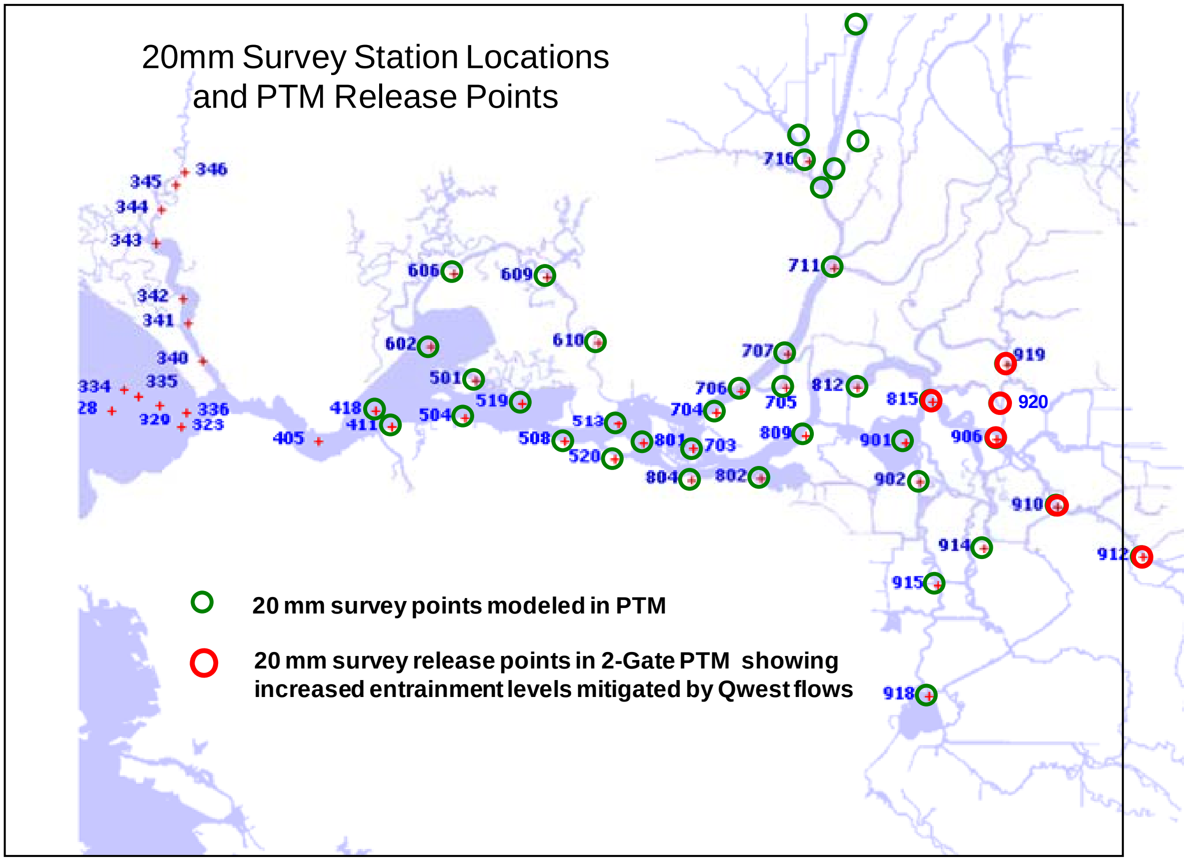

Figure 5-4. 20 mm Smelt Survey, Particle Release Points and 2-Gate/QWEST Operations

Table 5-4. % Change in Entrainment from Release Point #919

Survey Location /Release Point	% Change in Entrainment from Release Point #919							
	Feb-Jun						Dec-Feb	
	9-Jun-99	12-Jun-02	15-May-02	30-May-02	21-May-03	12-May-04	16-Dec-03	30-Dec-04
Historic + 2-Gates	+12	+16	+12	+24	+14	+12	-7	+9
Historic + 2-Gates + QWEST > -1,000 cfs	+9	+1	+7	+4	+4	+12	-21 [5]	+7
Historic + 2-Gates + QWEST > 0 cfs	+8	-10	+7	-8	0	+8	-26 [5]	+4

[5] -74% change in entrainment observed in Historic + 2-Gates + QWEST>-1,000 cfs, when exports were curtailed to match San Joaquin River flow during the gate closure.

Table 5-5. % Change in Entrainment from Release Point #906

Survey Location /Release Point	% Change in Entrainment from Release Point #906							
	Feb-Jun						Dec-Feb	
	9-Jun-99	12-Jun-02	15-May-02	30-May-02	21-May-03	12-May-04	16-Dec-03	30-Dec-04
Historic + 2-Gates	+6	+4	+9	+17	+10	+7	-10	-2
Historic + 2-Gates + QWEST > -1,000 cfs	+2	-9	+8	0	+1	+4	-21 [5]	-3
Historic + 2-Gates + QWEST > 0 cfs	0	-21	+6	-14	-1	+1	-26 [5]	-6

[5] -86% change in entrainment observed in Historic + 2-Gates + QWEST >-1,000 cfs, when exports were curtailed to match San Joaquin River flow during the gate closure.

MODE OF GATE OPERATIONS CONSIDERED DURING LARVAE/JUVENILE STAGE.

The DWR Potential Entrainment Index methodology, a model used to evaluate export levels and related entrainment, was used to test operational modes of the Project facilities during the March through June period when larvae/juvenile entrainment is of greatest concern. Using this methodology, differing 2-Gate operations and flow control measures were tested to reduce entrainment of simulated larval and juvenile delta smelt depending on the targeted distribution. Conditions were evaluated based on both gates closed, the Old River and Connection Slough Gates closed on flood-tide and open on ebb-tide and, and with only the Old River gate operated closed on flood-tide and open on ebb-tide. Table 5-6 describes the ranges of gates operation and other operational factors considered in these analyses.

Table 5-6 Conditions modeled to simulate change in potential entrainment with both gates operated closed on flood-tide and open on ebb-tide, and with only the Old River gate operated.

OMR Conditions	Operation Alternatives			Operating Criteria
OMR ≥ - 1,250 cfs	Gates Closed	OR Operating (flood-ebb)	OR & CS Operating (flood-ebb)	Start gate operations when 3 station daily mean water temps ≥ 12 C OCAP-adjusted QWEST @ San Andreas ≥ 0cfs Gates open during VAMP
OMR ≥ - 5,000 cfs	Gates Closed	OR Operating (flood-ebb)	OR & CS Operating (flood-ebb)	

A comparison of either one or both gates operating closed on flood-tide and open on ebb-tide was evaluated and results are summarized in Table 5-7. Operation of both the Old River and Connection Slough closed on flood-tide and open on ebb-tide increases the number of events in which there was a simulated net reduction in potential entrainment. However, under certain conditions the tidal operation of the Old River gate alone proves significantly more effective, particularly when distributions fall within the western Delta and generally within region of control of the gates. Considering this evaluation, a gate operation mode with Old River gate closed on flood-tide and open on ebb-tide and Connection Slough gate closed during such operations was selected for evaluation in the RMA analyses. This operation was applied to distributions of larvae/juvenile generally falling within in the region of control of the gates. This would be consistent with the application of RPA Component 2. An operational protocol is being established to guide the most favorable protections to smelt for testing in the demonstration program. Flexibility would be applied during field demonstrations to operate one or both gates in the flood-ebb operational mode.

Table 5-7 Simulated change in potential entrainment with only the Old River gate operated tidally and with both Gates operated tidally

20 mm Survey	Change in Potential Entrainment	
	OR Gate Tidal Operation % Change	OR & CS Gate Tidal Operation % Change
09 June 1999, Survey 5	-50.4%	-20.6%
15 May 2002, Survey 5	11.4%	-4.5%
30 May 2002, Survey 6	3.4%	-14.3%
12 June 2002, Survey 7	5.2%	-7.6%
21 May 2003, Survey 5	-12.3%	11.9%
12 May 2004, Survey 4	-32.4%	-26.2%

Two-Dimensional RMA-2 Analyses

SIMULATED REAL-TIME OPERATIONS WITH OCAP BO RESTRICTIONS USING ADULT AND LARVAE/JUVENILE SMELT BEHAVIORAL MODELS.

Adult Delta Smelt. All prior simulations of near-term solutions had modeled adult delta smelt as neutrally-buoyant particles. While reasonably accurate for the larval/juvenile stage, researchers have observed behaviors associated with increased turbidity and decreased salinity in preparation to moving inland prior to spawning (Grimaldo et. al as cited in USFWS 2008). Smelt distribution patterns are related to salinity and turbidity conditions during the winter in preparation for spawning (USFWS 2008). Scientists have postulated that the adult smelt may be "surfing" the tides as a means of staying within the desired water quality conditions. A new modeling package was developed to impart tidal 'surfing' behaviors on the particles in the RMA11 model. Once the delta smelt behavior model reasonably reproduced delta smelt distribution patterns in the Delta and occurrence at the export facilities, additional simulations were done with simulated operable gates in the Old River and Connection Slough. Simulations employed Project operations and the modulation of exports during December through February. These simulations demonstrate that the turbidity distribution (and therefore the distribution of adult delta smelt) can be managed generally within the region of control of the Project. Within this region, Project operations and related flow control measures have been shown through the model to be effective in dramatically reducing the entrainment risk of adult delta smelt from the CVP and SWP pumping facilities.

Larvae/Juvenile Delta Smelt. To correlate observed and modeled distributions and abundance of larvae/juvenile delta smelt, the RMA11, RMA2 and RMA-PTRK models have evaluated the larval and juvenile delta smelt period, roughly from March through June, for differing hydrologic conditions. For each condition, hatching rates have been determined by "tuning" to match distributions established by the 20mm surveys and, if possible, observed salvage. The hatching period and mortality rates used in the simulations have been specified based on published findings from credible researchers. Delta smelt density predictions were compared with 20mm survey observations and the predicted delta smelt salvage was compared with salvage observations at the Skinner Fish Facility and the Tracy Fish Facility including factors necessary to estimate pre-screen losses and salvage efficiency. The model evaluated the percent of larval/juvenile delta smelt population entrainment by the combined export facilities, the percent flushed from Delta, and the percent that remained within Delta.

Computer simulations of adult delta smelt distribution with habitat seeking behavior were performed for historic periods. Simulation points representing adult delta smelt were initially placed in regions of acceptable habitat at the start of the simulation period. Key constituent elements of adult delta smelt habitat were characterized by salinity (EC) and turbidity. Options were added to the model to influence sensitivity to habitat gradients, chance of incorrect directional choices, and resistance to tidal flow velocity. Behavioral characteristics were adjusted to attempt to replicate entrainment (salvage) at water export facilities. The 2-Gates Project operations were coupled with flow management measures of the OCAP BO.

Adult delta smelt distribution, including entrainment at the SWP and CVP facilities were determined through simulation using modified operations scenarios for the OCAP BO baseline and OCAP plus the 2-Gate Project using the RMA Adult Behavioral Model. Models were run for the December through February months for the 1999-2000, 2001-2002, 2003-2004 and 2007-2008 periods. See Appendix E for more details. Sample results are shown in Figures 5-5 and 5-6. A comparison of Figures 5-4 and 5-5 shows that in addition to the OCAP required OMR controls, the control of QWEST to be greater than or equal to zero cfs at San Andreas is effective in reducing modeled entrainment at the SWP and CVP facilities is nearly 0%. It is expected that proper application of such QWEST control through export modulation during the adult stage will be effective in managing turbidity distribution and hence, the distribution of adults generally within the region of control of the gates.

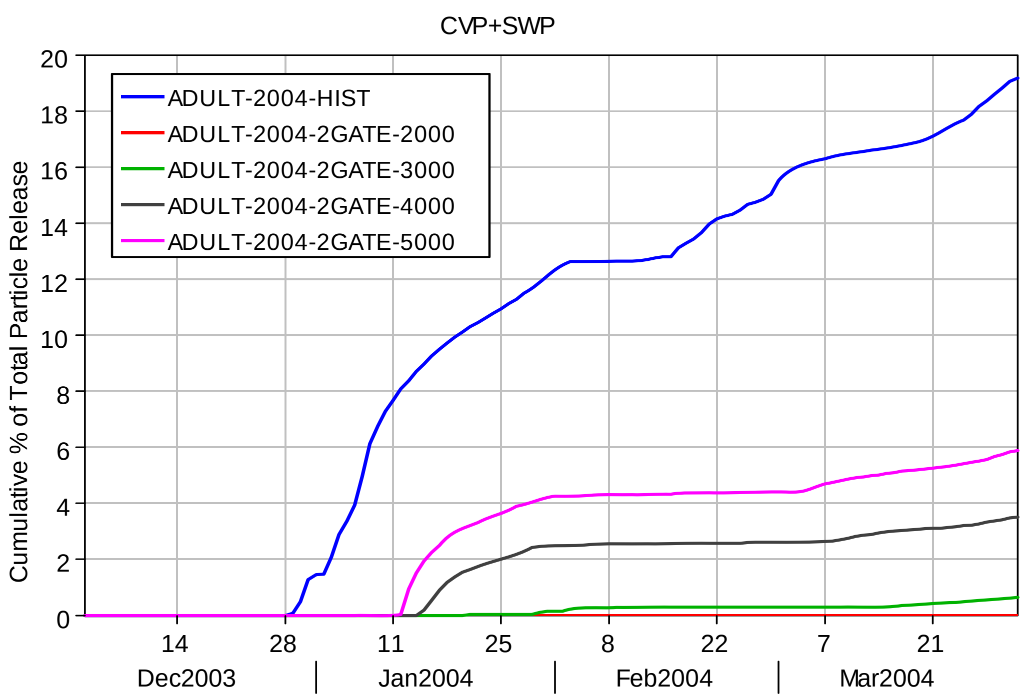

Figure 5-5 Cumulative simulated entrainment of particles representing adult delta smelt recovered at the CVP and SWP facilities, December 2003 through March 2004, with alternative OMR flow limits .

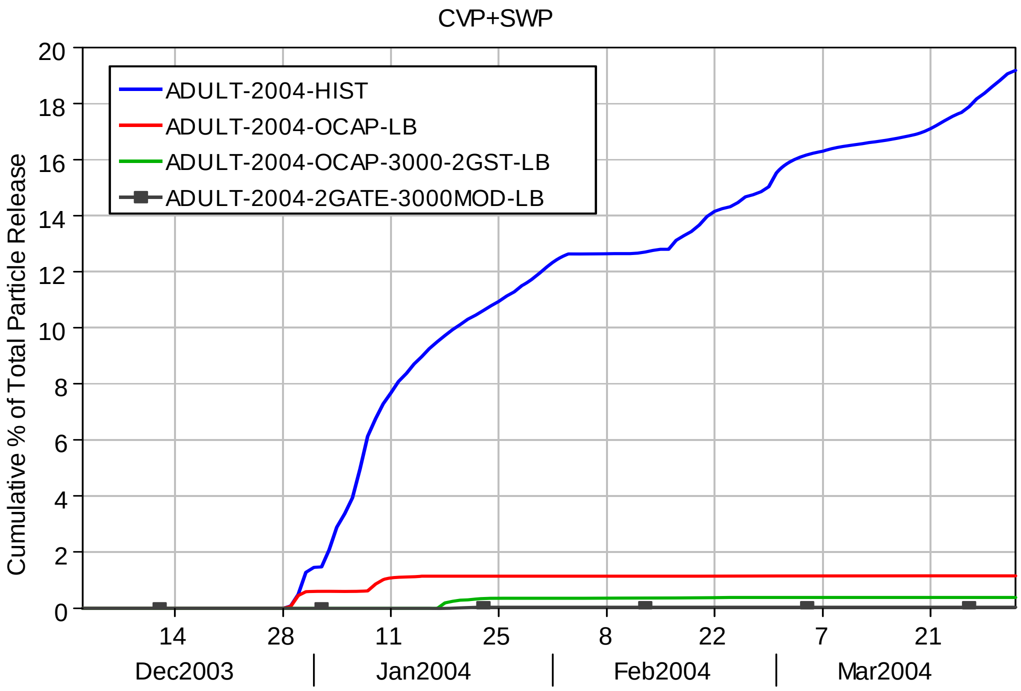

Figure 5-6 Cumulative simulated entrainment of particles representing adult delta smelt recovered at the CVP and SWP facilities, December 2003 through March 2004, with -3000 cfs OMR flows during RPA1 and -1250 cfs during RPA2 For the 2-gate case, exports were reduced briefly near the end of January to maintain positive QWEST at San Andreas Landing.

These simulations were used in RMA Bay-Delta Model and RMA-PTRK for passive particle tracking with post processing analysis of hatching and mortality. Modified operations scenarios were simulated for revised export flows according to OCAP guidelines and OCAP plus 2-Gates operations to determine resulting larval and juvenile delta smelt distribution and entrainment. Simulations were conducted roughly from March through June for the 2002 and 2004 historic periods. Analyses to adjust simulation results for mortality/hatching are underway and will be reflected in the final simulation results. The hatching rates estimated for historic conditions will be applied without modification to the various operations scenarios, focusing on the effects after initial hatching.

The combined effects of the 2-Gates, OMR -5,000 cfs restrictions, and supplemental QWEST ≥ 0 cfs suggests resulting larvae/juvenile entrainment can be maintained near OCAP OMR -1,250 cfs entrainment levels. Figure 5-7 displays the forecast of reduced entrainment at the export facilities with the implementation of the Project. Each of the Project simulation displays less predicted entrainment than either of the simulations of OCAP BO restricted OMR flow regimes.

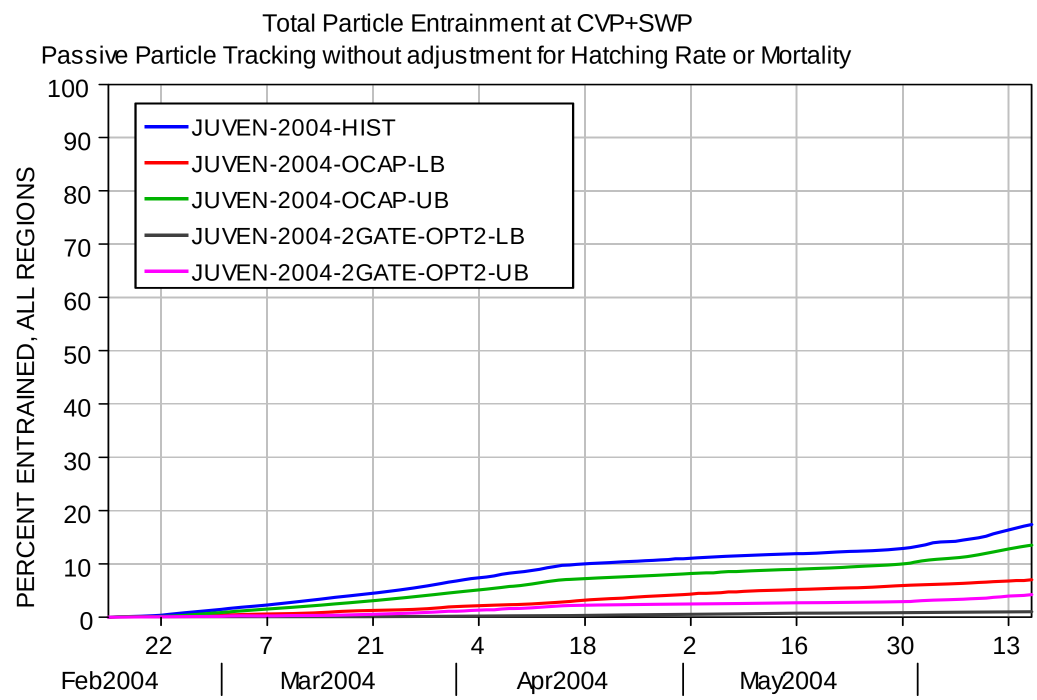

Figure 5-7 Comparison of 2-Gate cumulative simulated entrainment of particles representing larval/juvenile delta smelt recovered at the CVP and SWP facilities from all regions of the Delta (not adjusted for hatching rate or mortality).

5.3 CONSTRUCTION EFFECTS ON AQUATIC SPECIES

Construction activities include levee clearing of rip rap and vegetation at each shoreline at each site, dredging (clamshell dredge), dredge spoil disposal, sheet pile dike installation (vibration-driven), placement of rock in the channel and on levees, installation of the gate barge (the gate barge is the barge and the gate structure, control house and all wiring and electrical components that are pre-installed on the barge, then barge is then towed to the site and sunk to the prepared foundation), and removal and reinstallation of the gate barge and lock rock at the end of the first season and beginning of next season. Foundation preparation for the gate barge involves dredging peat material estimated at 5,500 cubic yards for Connection Slough and 7,000 cubic yards for Old River.

Exposure to construction effects depends on the spatial and seasonal occurrence of different species and life stages (Table 5-8). The period of in-water construction at the two sites is up to five weeks in September-October 2009 for construction (install sheet pile wall, dredge barge foundation, and place foundation rock), two weeks in November for barge gate installation, and two weeks in July for removal (gate barges and about 200 feet sheet pile walls on either side in the Old River Channel, no sheet pile wall will be removed from Connection Slough). All in-water work for the 2-Gates Project will be conducted within the in-water work windows already established by the fish agencies to limit project impacts to listed salmonids (winter-run and spring-run Chinook, CV steelhead) and delta smelt. Therefore, it is anticipated that the immediate effects of construction on listed fishes will be minimal, although some individuals may still be found within the Project work areas.

Species that could potentially occur near the sites during in-water construction in September-October include CV steelhead (early migrating adults and rearing juveniles) and green sturgeon (migrating adults, juveniles), with a low probability of winter-run Chinook (juveniles). Species that could potentially occur during gate barge installation in November include CV steelhead (migrating adults and juveniles), green sturgeon (juveniles), and longfin smelt (migrating or spawning adults), with a lower probability of occurrence for spring-run Chinook (juveniles) and CV steelhead (juveniles). Species that could potentially occur near the sites during gate removal in July include green sturgeon (adults and juveniles), with a low probability of CV steelhead (juveniles entering Delta). Adult winter-run and spring-run Chinook would not likely occur at the Project sites because they stay in the Sacramento River during their upstream migration. The two construction sites on Old River and Connection Slough are located within designated critical habitat for delta smelt, CV steelhead, and green sturgeon (proposed). However, the existing habitat quality of these leveed, riprapped Delta channels for rearing of delta smelt and juvenile salmonids is poor.

Table 5-8 2-Gates Construction Timing and Duration and Likely Occurrence of Aquatic Species and Critical Habitat at Construction Sites

Construction Activity	Timing	Duration	Species Likely Occurring at Construction Sites	Critical Habitat
Construction of sheet pile walls, dredging barge foundation, installation of barge rock base and	September-October 2009	Five weeks	CV steelhead (adult, juvenile) Green sturgeon (adult, juvenile)	Delta smelt CV Steelhead Green Sturgeon
Installation of barge with gates and anchor rock	November 2009	Two weeks	CV steelhead (adult, juvenile) -unlikely Green sturgeon (juvenile) Longfin smelt (adult) unlikely *Spring-run Chinook (juvenile possible but unlikely)*	
Removal of argegates from both sites and sheet pile dikes from Old River only	July 2010	Two weeks	Green sturgeon (adult, juvenile)	

The assessment examines several potential effects from construction activities:

- Direct injury or mortality from dredging and placement of rock and the barge
- Behavioral, physiological or physical habitat changes or impairment in response to:
  - Underwater noise and disturbance
  - Turbidity and resuspension of sediments and contaminants and resettling on benthic habitats
- Alteration of benthic habitat by placement of rock and barge

5.3.1 Direct Injury and Mortality

Construction activities include dredging, sheet pile wall installation, rock placement, gate barge installation, gate barge removal and gate barge reinstallation. The principal risk of direct injury and mortality to listed species would be from striking, collision or capture in the bucket dredge or crushing due to placement of rock or installation of the gate barge and sheet pile dikes (especially for bottom dwelling species such as green sturgeon). By using a bucket dredge and disposing of spoils on land, the Project will avoid other potential effects of dredging, such as fish entrainment by hydraulic dredging and burial of benthic organisms and habitat by disposed sediments (Reine et al. 1989, Nightingale and Simenstad 2001, Hoover et al. 2005).

5.3.2 Noise and Disturbance

Noise associated with construction activities of the 2-Gates Project has the potential to adversely affect aquatic species. Transient noise from dredging, foundation preparation (i.e. rock placement), pile driving, surface machinery, and topside activities on the construction barge decks during installation of the gate structures on site may have adverse effects on fish in close proximity to the noise source. This effect is expected to be localized and temporary in nature. Furthermore, these activities will occur during periods when few listed species are likely present in the area (green sturgeon and CV steelhead).

High levels of underwater noise can adversely affect some fish species[4]. The effects of pile driving on fish have been assessed by NMFS and others (Hastings and Popper 2005, Popper et al. 2006, Carlson et al. 2007, NMFS 2008d,). Information is not currently available regarding transient underwater noise associated with dredging, rock placement, surface machinery and topside activities on the barge decks. However, it is not expected that these noise levels will reach the same levels as from pile driving. Fish impacts from exposure to pile driving activities were reviewed by Hastings and Popper (2005), and recommendations provided to protect fish from physical injury (Popper et al. 2006, Carlson et al. 2007). In 2008 NMFS, USFWS and DFG adopted interim criteria of a peak sound pressure level of 208 decibels (dB) referenced to 1 µpascal per second (re: $1\mu Pa^2$-s) and a cumulative sound exposure level (SEL) of 187 dB re: $1\mu Pa^2$-s (Fisheries Hydroacoustic Working Group 2008, ICF Jones & Stokes and Illingworth & Rodkin 2009). Although these criteria were specific to percussive pile driving, they have served as a general guideline for noise thresholds for the onset of physical injury in fish exposed to the impact sound associated with pile driving (NMFS 2008d).

Sheet and king pile driving is expected to generate the greatest levels of underwater noise. Rock placement is also expected to generate underwater noise. These activities may generate sharp transient noises from metal components (buckets, scoops, etc.) striking rock that will propagate into the water column. The noise will be transient, occurring over a five week period. The 2-Gates Project will use a vibratory hammer to install the sheet pile dikes and king piles (wall) between the gate structure and the levee at reach site (see appendix G and H for details).Vibratory hammers are generally much quieter than impact hammers and are routinely used on smaller piles (ICF Jones & Stokes and Illingworth & Rodkin 2009). Although peak sound levels can be substantially less than those produced by impact hammers, the total energy imparted can be comparable to impact driving because the vibratory hammer operates continuously and requires more time to install the pile (ICF Jones & Stokes and Illingworth & Rodkin 2009). Sound levels during vibratory pile driving were measured at the City of Stockton Downtown Marina (Power Engineering 2008). Peak sound pressure levels ranged from 184 to 202 dB re: 1µPa, while accumulated SEL's ranged from 181 to 195 dB re: $1\mu Pa^2$-sec, as measured at 10 meters from the pile and mid-water depth (approximately 2 to 3 meters below the water surface). The duration of pile driving ranged approximately 6-12 minutes, with periods of 11 - 71 minutes between pile driving (Power Engineering 2008). The peak sound pressure levels were below recommended levels, while the accumulated SEL's slightly exceeded the recommended criteria by 8 dB re: $1\mu Pa^2$·sec,. It is anticipated that pile driving associated with the 2-Gates Project would have similar results in terms of SEL and peak sound pressure levels. This combined with the relatively short duration expected to drive each king pile and sheet pile along with an anticipated period between pile driving, and the timing of work within established in-water work windows suggest that physical injury to fish is unlikely.

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[4] Three metrics are commonly used in evaluating hydroacoustic impacts on fish: peak sound pressure level (LPEAK), root mean square (RMS) sound pressure, and sound exposure level (SEL) (ICF Jones & Stokes and Illingworth & Rodkin 2009). SEL is defined as the constant sound level acting for one second, which has the same amount of acoustic energy as the original sound (Hastings and Popper 2005). Reference sound levels from pile driving normally are reported at a fixed distance of 10 meters. Underwater peak and RMS decibel levels are usually referenced to 1 micropascal (µPa), and the SEL is referenced to 1 micropascal squared per second (dB re: $1\mu Pa^2$-s). (Hastings and Popper 2005).

Anticipated responses of any fish within the work area would more likely be behavioral in nature (startle response, avoidance etc.), although these would diminish with distance from the construction sites. Hastings and Popper (2005) concluded that data are lacking on behavioral responses to pile driving, such as a startle response to noise or movement away from highly utilized habitats impacted by sound. Carlson et al. (2001 cited in NMFS 2008c) reported migrating juvenile salmon reacting with startle behavior in response to routine channel maintenance activities in the Columbia River. Some of the fish that did not immediately recover from the disorientation of turbidity and noise from channel dredges and pile driving swam directly into the point of contact with predators.

5.3.3 Turbidity and Resuspension of Sediments

The main impact from construction is likely to be resuspension of channel sediments during in-channel activities. Site preparation in September and October includes dredging, followed by pile driving and installation of the sheet pile dike and rock placement. In November, the barge with gate will be installed and lock rock placed.. Sediments resuspended during dredging operations pose a variety of water quality and ecological concerns (Nightingale and Simenstad 2001, Bridges et al. 2008). The turbidity plume in the immediate vicinity of a dredging operation could influence the behavior, growth or health of fish and other organisms. The change from background levels, the type of suspended sediment, its concentration and duration, and species and life stage of fish are all factors to consider in evaluating the effect of exposure (Newcombe and Jensen 1996). Some effects that could occur in the Delta include avoidance of a turbidity plume and altered foraging and predation dynamics.

Foundation preparation for the gate barge consists of dredging peat material estimated at 5,500 cubic yards for Connection Slough and 7,000 cubic yards for Old River. Dredging the peat sediment is expected to release a combination of organic and inorganic sediments into the water column, with associated potential reductions in dissolved oxygen. Barrier construction activities would increase localized turbidity at the two project sites that would extend downcurrent from the installation site due to tidal flow. Although this increase in turbidity may affect fish by inducing avoidance of the plume, temporarily disrupting feeding, or disrupting resting or movement behavior, green sturgeon and steelhead are strong swimmers capable of moving away from the area of disturbance.

These effects would be limited in scope, due to the relatively small construction area (approximately 1.5 acres) and limited duration of construction. Once in-water construction stops, water quality is expected to return to background levels within a few hours, depending on hydrodynamics and the amount and size of fines in the channel sediments. The potential for exposure is therefore limited to those fish that may be present during the construction season (green sturgeon and juvenile steelhead) and they would avoid adverse conditions.

In-water construction activities also have the potential to distribute sediment-borne contaminants, if present, into the water column and onto nearby substrate, where they could be taken up by benthic organisms. Resuspension of contaminated sediments could have adverse effects on fishes that encounter the sediment plume, even at low turbidity levels. These effects will be localized and temporary, although some effects could persist if the mobilized sediments are contaminated and enter the benthic food chain. Contaminant mobilization, contaminant leaching, bioaccumulation, and trophic transfer through the food web can occur during or as a result of the dredging (Bridges et al. 2008). Green sturgeon could be affected because they are benthic foragers and can bioaccumulate contaminants over their long lifespan. The potential for this effect is related to the degree of contaminants in the sediments to be dredged and the total area disturbed. It is not known whether contaminated sediments are present at the two construction sites.

Construction vessels could potentially release contaminants into the water column due to runoff of oil-based materials during operations. This could affect fish through impaired water quality and substrate quality. Surface contaminants would be addressed in a Spill and Pollution Prevention Plan, which will outline actions to reduce impacts from this activity and address responses to potential spills. The implementation of BMPs and other protection measures would mitigate the potential effects on fishes and their habitat.

5.3.4 Altered Physical Habitat

Installation of the rock foundation and the barges would directly affect a total of about 65,000 square feet of channel bottom, approximately 30,000 square feet at Old River and approximately 35,000 square feet at Connection Slough. This action would replace approximately 1.5 acres of soft bottom habitat of peat and mud with rocky bottom habitat and two barges, which in turn will affect the benthic community structure. Species adapted to the soft peat and mud habitat will be replaced, in this particular area, with those more adapted to a firm surface. This alteration or reduction of the benthic community could potentially change the foraging habitat for green sturgeon. Pelagic feeders such as delta smelt and longfin smelt would not be affected by alteration of the channel physical habitat. The gate structures would attract predatory fish, thereby increasing predation risk for Delta smelt, longfin smelt and juvenile salmonids. Gate structure installation would alter near field channel hydraulics changing the channel from mostly laminar flow to locally turbulent flow conditions during a portion of the tidal stage down current of gate (Appendix E). This change would be most notable in Old River where a large volume of tidally driven water passes during each tidal cycle.

The Old River and Connection Slough sites are within the designated critical habitat for delta smelt, CV steelhead, and green sturgeon. Installation of the gates would affect certain PCE's for these species. For delta smelt, this would affect the PCE for Physical Habitat including spawning substrate. The scale of any potential impact is discountable, however, given the relatively small footprint of the Project on the substrate. For CV steelhead juveniles, the quality of freshwater rearing habitat is affected by habitat complexity, food supply, and presence of fish predators. The baseline condition of freshwater rearing habitat within Delta channels, however, is already degraded, and installation of the Project would not exacerbate this degradation. For green sturgeon juveniles and adults, attributes of tidal freshwater habitat that would be altered are principally benthic foraging habitat. However, the overall amount of habitat altered is small relative to what is available in the Delta, so the action is not likely to adversely affect the prey base for green sturgeon or juvenile salmon populations. Migratory corridors for emigrating CV steelhead juveniles and for green sturgeon adults and juveniles would not be substantially blocked by the gate structures because the sloped lock rock along each side of the barges will assist sturgeon in moving across the gate structure and the gates will be open during most of the operational period. The gates would be closed up to an hour a day from December into late February or March, and then operated tidally (closed on flood and open on ebb tides) from then until mid-April. Gates would be open during the VAMP period (mid April to mid May), then operated tidally into June, but open on weekends and holidays to allow for vessel navigation.

Construction on the levees would disturb existing emergent or riparian vegetation and habitat resulting in reduced shoreline vegetation and any riparian function it may have in supporting juvenile Chinook that utilize the area. Reductions in functions may include loss of shading and stabilization of sediments and loss of insect prey items for juvenile Chinook (Toft et al. 2004). However, the existing riparian function is already degraded and very small in relation to what is available in the Delta. In conclusion, the Project construction would not have a significant effect on the physical habitat for the listed aquatic species.

5.4 OPERATIONS EFFECTS ON AQUATIC SPECIES

The gate structures and their operations will have several effects on listed aquatic species including changes to physical habitat, flow patterns, and predation. Changes to physical habitat conditions result from installation of rock, gate barges, sheet pile walls and boat ramps. Structures change physical habitat conditions in a channel cross section that was primarily composed of open water channel with a soft sediment bed and bordered with a shoreline of tule-fringed rip-rapped levees on either side. The otherwise open water habitat of the channel is occupied by vertical steel walls that extend from the bed to above the surface creating vertical walls with little habitat value. Water velocities are low near the wall and slow eddies may develop in the backwater areas between the gate and levee. The barges create a shallow shoaling area in the middle of the channel. Shoaling areas can create tidal rips during large tidal changes as velocities increase across the top of the barge, then decelerate upon again reaching deep water. The deck of the steel barge provides poor quality bottom habitat with limited complexity to support invertebrates. Piles and decks for the boat ramps create structure in the nearshore area and can also provide shade, but the use of the boat ramps would disturb fish using these areas. These areas may provide habitat for predators, both fish and birds. The interstices in the rocks used to lock the barge in place provide numerous underwater hiding spots along sloping faces on both sides and ends of the barge. This can provide habitat for crayfish, catfish or other aquatic cavity dwellers.

Gate installation and operation will attract predatory fish to the structure or favorable conditions created by the structures. The gate structures will change the flow field in close proximity to the barges. The constrained channel cross section will change the mostly laminar flow of these channels to areas of turbulent flow during large tidal changes when water accelerates from the high side of the structure through the gate to the low side. These velocity jets will create eddies and shear zones along their sides that predator fish can use to feed on smaller fish being swept along with the current. Predatory fish in the Delta (primarily striped bass, largemouth bass, sunfishes and catfish) are good at exploiting situations where food is abundant or where features exist that enhance feeding opportunities, such as crevices or turbulent flows. For example, large populations of striped bass occur inside Clifton Court Forebay and schools of striped bass are known to occur in the vicinity of the salvage release sites. The gate structure would provide permanent (sheet pile wall, barge, lock rock and boat ramp) structures that provide interstitial spaces, topographic features or currents that are used by predatory fish. Navigation requirements and operation of the boat ramps and gates on a 24/7 requirement means that safety lighting will be installed at the gates. Flood lights need to illuminate the gate, sheet pile walls and boat ramp. Lighting may attract fish into lighted areas. Night predators such herons, other birds and raccoons may also take the opportunity to use the light sources as a means of gathering food. Predators that are attracted to the gate result in the loss of individual delta smelt, salmon and CV steelhead, but the overall effect of the gate structures on predator populations in Old River and Connection Slough would not result in populations level effects to these listed species.

When the gates are closed, the channel ends next to the gate will function much like a dead end slough, and water quality condition may slightly degrade with lower dissolved oxygen, change in salinity and debris build up. These conditions would be transient and would dissipate upon gate opening.

The Project operations will affect hydrodynamics in the region of influence. The following analysis of operation effects is based on hydrodynamic and behavioral simulations conducted for these analyses. Project operations will minimize the entrainment of listed fish species, primarily delta smelt relative to baseline conditions, in the CVP and SWP south delta pumping facilities. Details of the hydrodynamic and behavioral simulations efforts used in these analyses were presented in Section 5.1 and are provided in more detail in Appendix D. Results from the modeling inidcate a decrease in the entrainment of adult delta smelt by the export facilities by controlling the distribution of water quality characteristics that are correlated with migration of pre-spawning adults into the central and south Delta. Results from the simulations also indicate a decrease in the entrainment of larval and juvenile delta smelt over OCAP required OMR by operation of the 2-Gates consistent with OCAP flows and management of QWEST in the San Joaquin River at San Andreas Landing.

5.4.1 Potential Effects to Delta Smelt

The Project will benefit delta smelt by limiting pre-spawning adults from moving south of the gates, and thus limiting the distribution of adults, eggs, and larvae from reaching the south Delta. Fish entering the south Delta are highly vulnerable to entrainment at the pumping facilities, and subject to increased predation and poor habitat conditions. Reproductive success in the San Joaquin portion of the Delta is reduced because many adults and most larvae have been entrained and lost during transport to and from spawning sites to rearing areas (USFWS 2008). The adult delta smelt prevented from entering the south Delta would need to find other areas to spawn, but they and their progeny would be less vulnerable to entrainment, predation and poor habitat conditions.

The following sections discuss the Project effects in further detail by life history stages and critical habitat PCEs. During the December to June gate operation period, all life stages of delta smelt may be present in the vicinity of the Project facilities. Adults would predominate in December through February, and other life stages would increase in abundance from February through June. Most adults die after spawning, so their numbers would tend to decrease after the peak of spawning (usually by April or May). Juveniles would increase in abundance through June. Historically, salvage densities for delta smelt have been highest during May and June. In wet years spawning and migration tend to occur further west in the Delta than in dry years when delta smelt migrate further up the rivers to access freshwater spawning habitat. This pattern implies that direct and indirect effects and operations may be greater in dry years than in wet years.

5.4.1.1 Life History Stages

MIGRATING AND SPAWNING ADULTS (~DECEMBER THROUGH MARCH)

Adult smelt begin moving inland from the western Delta when first flush flows increase turbidity (greater than or equal to 12 NTUs) and decrease salinity. When the higher turbidity in the west or central Delta bridges the gap through Old and Middle rivers, this links with the high turbidity waters in close proximity to the pumps. Once the turbidity bridge occurs, adult delta smelt tend to move more easily move into the south Delta. Recent estimates of annual entrainment have ranged from 10 to 60 percent of the delta smelt population (adults and progeny combined) per year from 2002 to 2006 (Kimmerer 2008). Since most adult entrainment occurs between mid-December and March, the gates will be operated during this period to modulate flows in Old and Middle Rivers and thus manage distribution of higher turbidity conditions that cue adult pre-spawning migration from extending into the south Delta. Operation of the project will reduce the risk of entrainment for adults.

The results from RMA's delta smelt behavioral simulations indicate that installation and operation of the Project would manage water quality to keep adults north of the area to avoid becoming entrained by the pumping facilities. Figure 5-8 shows the simulated distribution of adult delta smelt for different operational scenarios. Under current operations (Figure 5-8, upper left frame), delta smelt are distributed throughout the south Delta as well as other channels. The OCAP restrictions (Figure 5-8, lower left frame) also show delta smelt dispersing into the south Delta channels but not as extensively as under historic conditions. Simulations of OCAP with 2-Gate reveal that delta smelt distribution extends only to about Woodward Canal (Figure 5-8, upper right frame). The Project would limit the distribution of adult delta smelt from extending further into Old and Middle Rivers toward the south Delta channels, thus reducing entrainment risk. Model runs indicate that operations of the 2-Gate with OCAP OMR flows and QWEST result in better reduction in entrainment than OCAP OMR flows alone (Figures 5-5 and 5-6).

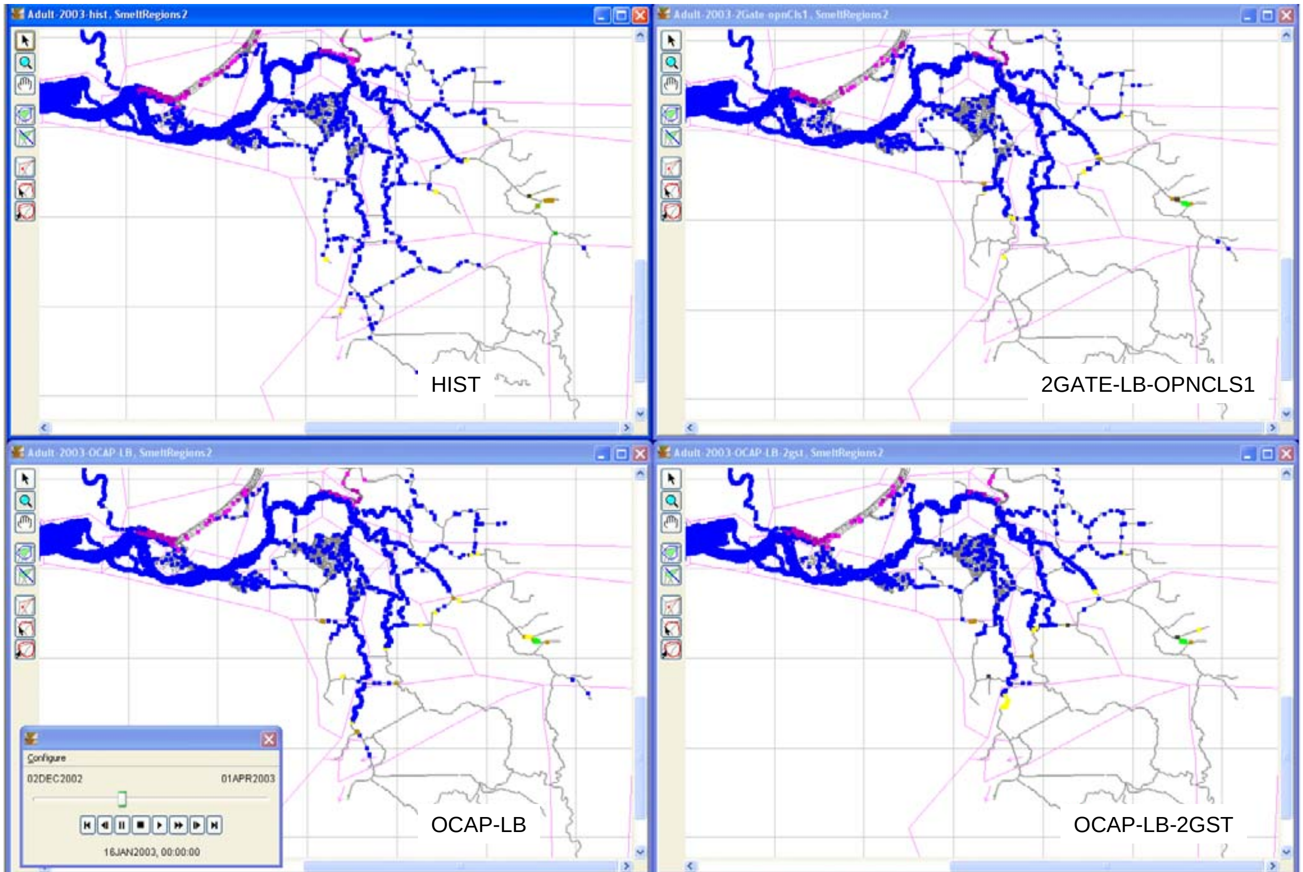

Figure 5-8. Adult Delta Smelt Particle Distributions for historical conditions (HIST), OCAP operations (OCAP-LB), and 2-Gates scenario (2GATE_LB-OPNCLS1). The difference between OCAP and OCAP with 2-GATE is the comparison of lower left with upper right figures.

<u>LARVAL AND JUVENILE DELTA SMELT TRANSPORT (~MARCH THROUGH JUNE)</u>

Delta smelt spawning typically commences once Delta-wide average water temperatures reach 12 ºC, approximately February or March. Once this occurs, gates will be operated to protect larval and juvenile delta smelt from entrainment into the south Delta, as informed by 20-mm surveys of larval distribution. The Old River gate will be operated tidally: open on ebb tides and closed on flood tides. The Connection Slough gate will be closed, except when opened during slack tide (an hour per opening, four times per 25 hour tidal cycle) or for boat navigation on weekends. Gate operations will be coordinated with OCAP restrictions and QWEST. Gates will also be open continuously during the VAMP periods (mid-April to mid-May) and on weekends from Memorial Day through June.

The Project would enhance survival of larval and juvenile delta smelt. As discussed above, operations will affect the distribution of turbidity and salinity, which would result in redistribution of pre-spawning adult delta smelt in the inner Delta and consequently would change the distribution of larval and juvenile delta smelt. The gate structures and their operations will influence habitat conditions by affecting hydrodynamics in the region of influence. The Project will balance net flows in Old and Middle Rivers between the San Joaquin River and Woodward Cut, thus reducing entrainment risk at the SWP and CVP export facilities. The Project operations will also complement QWEST flows (maintained in the San Joaquin River at San Andreas Landing greater than zero), which assist downstream movement of larvae and juveniles to rearing habitat in the low salinity zone in Suisun Bay.

RMA's behavioral simulation shows a net decrease in the entrainment of larval/juvenile delta smelt when the Project is operated and OMR flows are balanced. Figure 5-7 compares modeled entrainment rates at the SWP and CVP facilities under various scenarios (historic, upper and lower OCAP BO, and Project operations using the OCAP upper and lower bound OMR flow rates). The Project achieves a 10-12% reduction of cumulative entrainment compared to OCAP restrictions alone for the hydrologic conditions and Delta-wide smelt distribution that occurred in 2004.

Project operations would reduce the number of larval and juvenile fish being drawn into the south Delta. The gates will remain open during the VAMP period (mid-April to mid-May). During VAMP, San Joaquin River inflow is increased and exports are decreased. These conditions reduce the volume of water drafted up Middle and Old Rivers toward the pumps. Gate structures will constrain the cross section in Old River and Connection Slough, further limiting reverse flows in these channels south of the two gate structures.

The benefits of Project operations may be greater than the model results indicate. The current simulations are based on the existing distribution of larval smelt, as indicated by the historic 20-mm survey data. However, Project operations will change distribution of turbidity and salinity, which would result in redistribution of spawning adults and therefore changes in distribution of larvae and juveniles (i.e. fewer closer to the south Delta). The model, which works from existing 20-mm data, would need be adapted to reflect the new distribution of delta smelt.

JUVENILE REARING AND ADULT DEVELOPMENT (~JUNE THROUGH DECEMBER)

Delta smelt move toward the western Delta and into Suisun Bay during later spring/early summer and are generally absent from the Delta during the warm summer months. They remain in the western Delta and Suisun Bay until early winter when they begin moving back inland. The Old River and Connection Slough Gates will not be operated from July into December when smelt are generally absent from the Delta. No adverse effects are anticipated during the juvenile rearing and adult development period.

5.4.1.2 Effects on Critical Habitat

The Project will enhance overall designated critical habitat for delta smelt. The Primary Constituent Elements (PCEs) include physical habitat (PCE#1), water (PCE#2), river flow (PCE#3) and salinity (PCE#4) and are discussed here for all life history stages. Adequate flow (PCE#3) and suitable water conditions (PCE#2) may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their tributaries. Use of south Delta habitat would be reduced by the Project operations. While the south Delta is encompassed within the designated critical habitat, the condition of several PCEs (#2 water and #3 flow) have been degraded by SWP/CVP operations that have altered river flows and increased entrainment risk (USFWS 2008). Under current conditions, a significant proportion of progeny produced in the south Delta are probably entrained at the pumping facilities. While this area may have historically been used for spawning, it is believed that the south Delta is not currently an important source for production of delta smelt. Shifting spawning activity away from the south Delta to other areas where the progeny are more likely to survive would reduce the negative effects and could benefit the species. Adult smelt would still be able to access the lower San Joaquin River and other areas of the central and northern Delta by migrating up the main stem of the San Joaquin River.

The Project has a minor effect on physical habitat (PCE#1) by the placement of the gate structures in Old River and Connection Slough. About 1.5 acres of habitat is changed by the dredging, barge placement, lock rock, sheet pile wall installation and boat ramps, but delta smelt are open water species and are not known to frequent shoreline areas or channel beds except during spawning. Most of the habitat changes to the physical habitat occur at the bed of the channel or along the shoreline so would have minimal effect on delta smelt. The 1.5 acres at the two project sites make up a very small percentage of the entire channel area used by Delta smelt. The change to the physical habitat PCE is inconsequential given the small footprint of the Project structures on physical habitat available in the Delta.

PCE #2 is water for all life stages of delta smelt. The condition of PCE #2 has been substantially reduced (USFWS 2008). The current Delta has little of its historic intertidal marsh lands and many of its historic sloughs and channels have been cut off or altered. The pattern and quantity of inflow and outflow has been highly altered by upstream storage and diversions from the Delta. The 2-Gates project would reduce the amount of water drafted through Old River from Franks Tract. Water not drafted from the western Delta would be drawn from Middle River, Turner and Columbia Cuts and Old River upstream of the pumps. This would potentially benefit larval and juvenile delta smelt in the western Delta by reducing their movement into south Delta channels and subsequent loss via export facilities.

In conclusion, the Project would have a net beneficial effect on designated critical habitat for delta smelt. Operations would enhance the condition of critical habitat by reducing entrainment risk in the south Delta (PCEs #2 and #3) and would not significantly degrade the condition of physical habitat (PCE #1).

5.4.2 Effects to Chinook Salmon and Steelhead

5.4.2.1 Potential Effects by Life History Stages

Winter-run and spring-run Chinook and CV steelhead occur in the Delta during their adult and juvenile migratory life history stages. Some rearing may also occur in the Delta during juvenile emigration. Potential effects for the different salmon runs and CV steelhead depend on the timing and the river systems they use. Runs that have peak migratory or rearing life history stages in the Delta during the construction and operation periods of the 2-Gate Project would have a higher potential to be affected by the project. Winter-run and spring-run Chinook and CV steelhead runs that access the Sacramento River and tributaries are less affected by the project compared to fall-run Chinook or CV steelhead runs using the San Joaquin or Mokelumne River systems.

The Biological Characteristics, Status of the Species and Critical Habitat (as applicable) for Winter-run and spring-run Chinook and CV steelhead are presented in Section 3. This analysis presents the effects common to all salmonids, followed by a description of unique attributes for individual runs based on the species, run timing or home river system. There is more information available for Chinook salmon than CV steelhead, but CV steelhead are expected to have similar behavioral responses once differences in run timing and distribution are accounted for.

EMIGRATION OF JUVENILE SALMON AND STEELHEAD THROUGH THE DELTA

Juvenile winter-run Chinook salmon generally occur in the Sacramento-San Joaquin Delta from December through April with a peak from February through April. Occurrence within the Delta may extend from October into June. The emigration period for spring-run Chinook salmon extends from November to early May. Juvenile spring-run Chinook salmon numbers are reported to peak in December and March and April in the lower Sacramento River and Sacramento-San Joaquin Delta. Historical Central Valley steelhead salvage data from the State Water Project and Central Valley Project provide salvage data indicate a high relative abundance of steelhead juveniles from February through May, moderate abundance in June and October – January, and minimal to no abundance from July – September. In summary most salmonid outmigration occurs during the winter and spring from October through May and perhaps into June.

Project operations from December through June would likely reduce entrainment of juvenile salmon and steelhead moving though the Delta. Limiting negative flows in Old and Middle River to keep delta smelt north or west of the gate would also provide improved flow or salinity cues for salmon and steelhead migrating toward the ocean.

Juvenile steelhead emigrating from the Mokelumne and San Joaquin Rivers take migration paths that would be different from Sacramento River fish. Mokelumne River steelhead would migrate along the same route used by Sacramento River steelhead or salmon that entered the central Delta via the DCC gates or Georgiana Slough. Operation of the 2-Gate Project includes an element to mitigate for entrainment of fish from those stations in the central Delta that are located around or upstream of the confluence of the Mokelumne River (Figure 5-3). By keeping QWEST at San Andreas Landing equal to or greater than zero, the 2-Gate Project would have minimal effect on steelhead from the Mokelumne River.

San Joaquin River steelhead could move through the Delta using several routes including moving into Old River downstream of Mossdale. Migration routes most likely take fish down the Grantline Canal before re-entering Old River near the intakes to the CVP and SWP. Figure 5-8 shows the difference in entrainment of neutrally buoyant particles to the CVP and SWP facilities from releases in the Grantline Canal for historic, OCAP and OCAP plus 2-Gate operations. Based on the lack of differences in entrainment rates among these different operational scenarios, the project would not adversely affect steelhead migration down Old River.

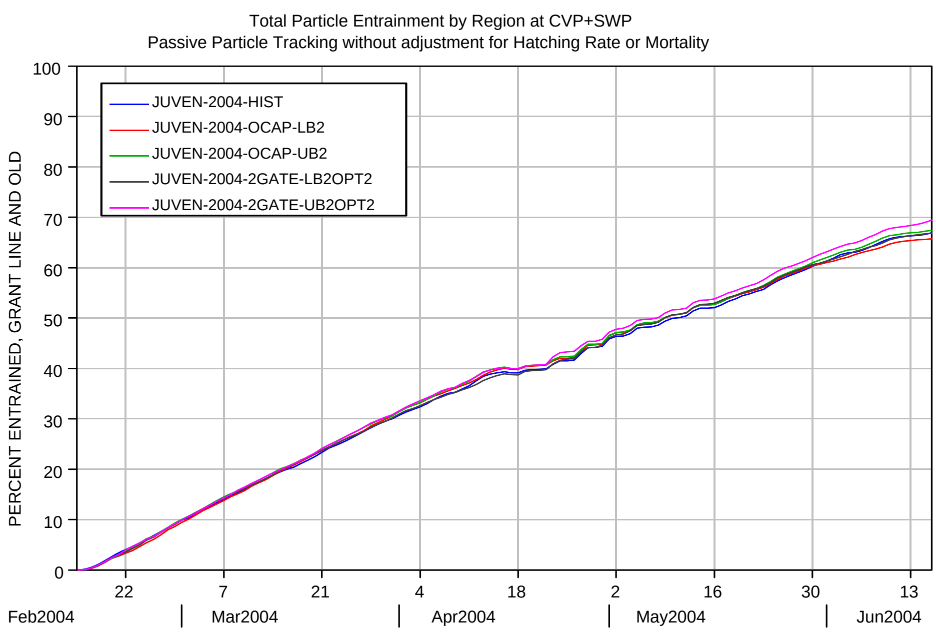

Figure 5-9. Entrainment effects of the 2-Gates project on juvenile delta smelt from the Grantline Canal insertion location comparing 2004 historic and simulated 2004 entrainment using the OCAP BO upper and lower bound OMR flow rates. See Appendix E for further details

MIGRATION OF ADULT SALMON AND STEELHEAD THROUGH THE DELTA

Adult immigration of winter-run Sacramento River Chinook salmon through the Sacramento-San Joaquin Delta generally occurs from December through June with a peak in March., while the immigration of spring-run salmon occurs from March through September with a peak in May and June. Adult immigration of steelhead through the Sacramento-San Joaquin Delta generally occurs from September through May with the peak in December through February. Unlike other species of salmon, steelhead do not necessarily die after spawning and downstream moving post-spawn adult steelhead (kelts) move through the Delta from January through May.

Construction of the project will occur outside of the winter-run migration period and at the extreme end of the spring-run migration period, and beginning of the steelhead run. Because of the location in the central Delta, winter and spring-run adults are highly unlikely to pass the gate sites during the construction period. It is also unlikely that steelhead will pass the gates sites during the early period of their upstream migration, however adult steelhead may be making their way toward the Mokelumne or San Joaquin river systems and could pass the gate sites.

Project operations have been shown to control the distribution of delta smelt to keep them out of the south Delta. Therefore, operations would also reduce entrainment of juvenile salmon and steelhead into the pumping facilities by keeping them away from the south Delta. This would tend to reduce entrainment risk for juvenile salmon and steelhead that are passing through the central Delta, Evidence suggests that steelhead using the Old River route from the San Joaquin River would not show much increased risk of entrainment (See Figure 5-8). Effects on Mokelumne and San Joaquin River salmon would be variable depending on the timing of the outmigration into the central Delta. 2-Gate 0perations that combine OCAP flow restrictions and QWEST flows would improve conditions for outmigrating salmon and steelhead that pass through the Mokelumne River on their way to the ocean.

The Project would have limited effect on adult migrating salmonids since Sacramento River upstream migrating adults would not be expected to pass the project site on their way upstream. Downstream migration steelhead kelts could be exposed to Project operations, and could become disoriented in channels conveying water toward the pumping facilities as they seek a route to the ocean. However, Project operations should reduce strong negative flows from Old River and balance negative flows in Middle River, and therefore should reduce the risk of entrainment of kelts into the Middle and Old River channels.

5.4.2.2 Potential Effects on Salmon and Steelhead Designated Critical Habitat

The 2-Gates Project would affect designated critical habitat for CV steelhead in the Action Area (there is no designated critical habitat present for winter- or spring-run Chinook). CV steelhead designated critical habitat in the Delta region as a whole will not be adversely modified as a result of the 2-Gates Project. Part of the intrinsic values of the PCE's listed for CV Steelhead critical habitat in the Delta is unobstructed passage of emigrating fish through the region, with conditions free of obstacles or risks (i.e. entrainment, predation) . This characteristic of the PCE's will be modified locally within Old River and Connection Slough by construction and operation of the 2-Gates structures since passage there would be intermittently obstructed during tidal operations. Upstream passage for adults migrating through the Old River and Connection Slough channels to habitats on the San Joaquin River system may be partially obstructed during winter operations. Gates would be closed mostly during flood tide periods, but passage would occur during slack water and the ebb tide. Migrating adults would be able to pass the gates and proceed with their upstream migration. If gates are closed the fish may be delayed for up to 12 hours. Upstream passage for adult CV steelhead migrating through other interior Delta channels will not be adversely affected by the 2 Gates Project.

The effect of gate operations on flows that can affect downstream passage by juveniles would be negligible. As with adults, this PCE (unobstructed passage) would only be modified locally, within Old River and Connection Slough at the sites of the gate structures. Since the gates will be closed intermittently, mostly during the flood tide, dominate flow upstream of the gates in Middle River would be toward the pumps, whereas flows in Old River would be variable - north of Railroad Cut it would be slack during gate closure or ebb during gate opening, whereas south of railroad cut, negative flow would dominate the channel. Juveniles passing the intakes for the CVP and SWP presently face negative flows in these channels. Operation of the 2-Gates would enhance downstream migration conditions in Old River between Woodward Canal and Railroad Cut by reducing negative flow. Negative flows would be markedly improved in Old River north of railroad cut compared to existing conditions, or conditions with only the OCAP BO restrictions. Juveniles that encounter closed gates during the ebb tide cycle could be delayed for up to 12 hours and could be exposed to predation during that time. Downstream passage of juvenile CV steelhead migrating through other interior Delta channels will not be adversely affected by the 2 Gates Project.

The gate structures would affect the passage PCE by increasing predation risk, but this effect would localized and would not adversely affect overall critical habitat in the Delta. The gate structures would attract predatory fish and the increased velocity of flows passing through the narrow gates may disorient individual CV steelhead in the immediate vicinity and provide shear zones and turbulent eddies during certain tidal stages that would attract predators. Predation risk would be a concern for juvenile steelhead but not for adults migrating through the sites of the gate structures. Although there would be local adverse modification of the critical habitat PCE of unobstructed passage for CV steelhead juveniles, designated critical habitat in other interior Delta channels will not be adversely modified as a result of the 2 Gates Project. Improved flows for adult and juvenile CV steelhead migration will occur in other interior Delta channels as a result of 2 Gates Project installation and operations. Therefore, the overall conservation value of these structures would be to improve critical habitat characteristics. Any adverse modification will be local to the gates structure sites and minor relative to the total critical habitat available within other Delta channels. The net effect would be neutral or beneficial. Outmigration success of juvenile CV steelhead approaching the gates from the north and east would be improved. In addition, gate operations will reduce entrainment of steelhead from the Sacramento and Mokelumne river systems at the CVP and SWP facilities.

Freshwater rearing habitat, another PCE of the Delta, is currently in poor condition, with leveed and rip-rapped channels that have low habitat complexity and low abundance of food organisms, and offer little protection from predation. Project operations would temporarily alter tidal inundation patterns that could affect tidal shallow water habitat, but this change is minimized by the periodic, not permanent, gate closure. Physical condition of freshwater rearing habitat would be affected in a local area near the gates, but the Project would not adversely affect freshwater rearing habitat in the Delta as a whole, The net effect of the Project on the function of CV steelhead critical habitat within the Delta would be neutral or slightly beneficial by reducing the risk of entrainment for the majority of the CV Steelhead population, which emigrates from the Sacramento River basin.

5.4.3 Potential Effects on Southern DPS Green Sturgeon

5.4.3.1 Potential Effects on Life History Stages

Green sturgeon adults and juveniles are in the Delta year-round and salvage indicate a low level of occurrence of juvenile sturgeon in all months. Juvenile sturgeon are much larger than delta smelt or salmonids. The majority of juvenile green sturgeon salvaged at the facilities and captured in trawling studies were 200-500 mm (DFG 2002 cited in NMFS 2008a), indicating they were 2 to 3 years of age (Nakamoto et al. 1995). Large sturgeon rarely show up at the salvage facilities because they are too big to fit through the trash racks.

Green sturgeon use the Delta as a migratory corridor as they move from the ocean to freshwater as adults and from freshwater to the ocean as juveniles. Most movement by adults occurs in deeper channels, while juveniles are more likely to use the shallow habitats for feeding and predator refuge (NMFS 2008b). Periodic closure of the gates could affect movements of juveniles and adults residing within the Delta, but the effect would be transitory. Telemetry has documented green sturgeon moving nondirectionally on the bottom presumably foraging, and swimming directionally closer to the surface (Kelly et al. 2007). Rock ramps on either side of the barges will also guide benthic sturgeon to move up and over the gates, which will be approximately 15 feet deep at the crest of the gates. Flow velocities through the gates would be greater when the gates are initially opened because the channel will be narrower than under baseline conditions. These flows are not expected to prevent sturgeon movements because even juveniles are relatively large and strong swimmers. Green sturgeon are tolerant of a wide range of environmental conditions experienced in the estuary (Kelly et al. 2007), so operational effects on water quality conditions are not expected to adversely affect this species.

5.4.3.2 Potential Effects on Southern DPS Green Sturgeon Proposed Critical Habitat

The Action Area encompasses part of the proposed critical habitat for green sturgeon, namely freshwater riverine systems. Specific PCE's within the Delta are food resources, principally benthic invertebrates and fish, migratory corridor through the Delta and lower Sacramento River for adults and juveniles, and uncontaminated sediments. As discussed earlier (Construction Effects Section 5.2.3.4), installation of the gate structures will alter a small area of soft benthic habitat, but the effect on food resources and sediment quality would be localized and would not impair the overall function of proposed critical habitat within the Delta. Project operations would not impair benthic habitat condition. Gate operations would not impede upstream migration of adults, because the two sites are not along the corridor from the ocean to spawning habitat in the upper Sacramento River. Periodic closure of the gates would have a transitory effect on movement corridors for juveniles and adults residing within the local structure sites within Old River and Connection Slough but would not affect passage through other interior Delta channels. The operations effects would not impair the condition of freshwater riverine habitat currently available in the Delta.

5.4.4 Potential Effects to Longfin Smelt

5.4.4.1 Potential Effects by Life History Stage

All life stages of longfin smelt may be present in the action area during the proposed operational period (December – June), and would be exposed to the direct and indirect effects of Project operations during this time. Adults would predominate in December through February, but would continue to be present through April, eggs and larvae would become abundant in February through April, and juveniles could start to occur in February and would increase in abundance through June.

The intent of the proposed project is to reduce movement of longfin smelt toward the export pumps. This will be achieved by placing physical barriers, the two barriers, in important migration routes on Old River and Connection Slough. The Project would also reduce fish movement toward the export pumps by increasing downstream flows in the central Delta in the vicinity of Frank's Tract. Operation of the Project may increase entrainment of longfin smelt that are located south and east of the region of control (in the vicinity of the Mokelumne, lower San Joaquin, and Middle Rivers

Project operations designed to significantly reduce entrainment of weak-swimming pelagic organisms from the west and central Delta would initiate in early December. These operations would reduce entrainment of longfin smelt in this region. Details of the hydrodynamic and biological computer simulations efforts used in these analyses are provided in Appendix E. Preliminary results from the optimization process indicate a significant decrease in the entrainment of delta smelt by the export pumps which would also be applicable to longfin smelt. Longfin smelt located north and west of this region would be unaffected by the Project. Longfin smelt located south of the Project facilities and along the mainstem of the San Joaquin River upstream from Prisoner's Point during the Project operational period (December through June) may be subject to increased negative flows (upstream) and increased entrainment potential. However, as shown in Figure 5-3, the Project would have negligible effects on entrainment of fish in the south Delta.

Longfin smelt could be present in the vicinity of Old River and Connection Slough sites during the operations period. Project operations would prevent longfin smelt (i.e., spawners and offspring), from being entrained from the Frank's Tract area into the conveyance channels of Old and Middle Rivers and transported directly to the CVP and SWP pumps. Based on particle entrainment, RMA simulations suggest that substantially fewer larval longfin smelt from Frank's Tract will be entrained at the diversion facilities with implementation of the proposed project (Figure 5-1). This will provide a greater benefit to longfin smelt in dry years than in wet years, when they are generally more abundant in the area of influence of the project, and their population is likely to be relatively small.

These conclusions are all based on the assumption that longfin smelt behave similarly to neutrally buoyant particles. Although larvae generally move passively in the direction of river flow, they are fairly strong swimmers and can maintain their position in the mixing zone of the estuary by moving up and down in the water column (Moyle 2002). Thus, their position in the estuary will depend not only on flow magnitude and direction but also on the location of X2. Adult and juvenile longfin smelt, on the other hand, are unlikely to move passively with the direction of flow. Consequently, it is possible, that the particle tracking model may not provide an accurate estimation of changes in entrainment after implementation of the proposed project, especially for spawning adults and juveniles.

Potential Effects on Longfin smelt Designated Critical Habitat

Critical habitat has not been proposed or defined for the longfin smelt therefore none will be affected.

5.5 EFFECTS OF MONITORING ON AQUATIC SPECIES

Increased sampling periods and intensity of delta smelt larvae and juveniles, additional tagging and observational studies requiring handling of fish and disturbance of habitats, may affect individual organisms in various ways. In general, knowledge gained from more precise real-time reliant decision making support data (water quality, hydrodynamics, and species presence data) will have a greater benefit to populations affected by entrainment or migration than the incidental take incurred during monitoring.

5.5.1 Water Quality and Flow Monitoring

Water quality and flow monitoring are expected to use existing station and networks using passive devices (grab sampling, deployed meters, etc.) and have no long-term effect on aquatic species. Maintenance of in-stream devices could create temporary disturbance from foot traffic or boat traffic where fish may leave the area.

5.5.2 Fish Monitoring

Seven fundamental fish monitoring programs operate within the Delta and include: Fall midwater trawl, Summer townet survey, spring Kodiak trawl, 20mm post-larval and juvenile delta smelt survey, the Mossdale Kodiak trawl survey, the Longfin smelt survey, and fish salvage monitoring. These programs have been evaluated for their potential effects and have been permitted for sampling, handling and take under various Delta evaluation programs.

5.5.3 Additional Monitoring or Enhancement of Existing Programs

5.5.3.1 Water Quality

2-Gate’s water quality monitoring includes initial deployment and weekly maintenance by technicians. The action includes a boat trip, and retrieval and redeployment of instruments. Technicians will use established boat access areas or hand carry smaller boats down the bank. These actions may temporarily disperse fish associating with the area but overall should have little to no effect on aquatic species.

5.5.3.2 Fish Monitoring

Spring Kodiak Trawl (SKT) The SKT time period will be expanded into December and sampling frequency at sites near the project area will increase to once/week. The intent of the extension is to achieve an earlier indication of entrainment risk when the gates are in operation. This will be at earlier period of the longfin and delta smelt spawning migrations, therefore lower abundance is expected form sample captures. The benefit of an earlier sample period to inform gate operation should compensate in overall greater survival of smelt than not having an extended sample period.

20mm Juvenile Smelt Survey The 20mm survey will increase in frequency from bi-weekly to weekly. Average mortalities will presumably be doubled at eight sample sites within the Project's area of influence.

Adult Delta Smelt Migration Study To support the turbidity/migration hypotheses underlying the spawning season operations, a special trawl study will be designed and conducted at 2 key points (Sacramento River near Decker Island and San Joaquin River at Jersey Point) triggered by the first major rain event of winter. To detect adult smelt movement into the delta during this period up to 6 trawls will occur at each site (about every two hours, through a 12 hour tidal cycle.) Most smelt captured in trawls die. The catch however is highly variable from trawl to trawl. A trawl-cam is in development that will be ready for testing this spring. The trawl-cam replaces the closed cod end of the net with a camera system capable of identifying, measuring and counting the catch. The catch is then passed out the end of net unharmed.

Juvenile Salmon/Steelhead Emigration Studies Central Valley salmon and steelhead tagging-based studies are shifting towards acoustic tag technologies. Generally, this involves the use of handling less fish for management information compared to traditional coded wire tag or other mark-recapture techniques. Active and planned studies such as VAMP-related research and East Bay Municipal Utility's delta migratory juvenile salmonid survival study schedule for 2010 utilize hydroacoustic technologies. 2-Gates salmonid evaluations propose to utilize this information and receiver network where feasible and provide additional location information for existing studies by establishing receiving stations in the Project area. The 2-Gate explicit evaluations will require tagging of additional salmonids for site specific information and may include up to ___ individuals. Hydroacoustic tags have demonstrated a ~1% mortality on salmonids (C. Mercato, pers. comm. HTI-Sonar) however; there is uncertainty about sublethal effects. There should be a minimal impact on fish handled for any additional fish used for hydroacoustic tagging studies in concert with existing studies.

Camera Monitoring for Predators Cameras will be used to periodically inspect gate areas for predators. Other than the potential for fish to avoid movement of the boat and be temporarily displaced upon positing the boat, the practice will be passive and have no effect on populations of fish. Authorized electrofishing may cause mortalities of predator or non-native fishes and may also cause mortality of delta smelt and salmonids. Prudent electrofishing protocol, such as no electrofishing if salmonids or native fishes are harmed during collection, will minimize negative effects on native fishes.

5.6 EFFECTS ON TERRESTRIAL SPECIES

Pursuant to section 7(a)(2) of the ESA (16 U.S.C.§1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The action may adversely affect giant garter snake, as well as the state-listed species previously mentioned in Section 3.2, if they are found within the Action Area. Based on the results of the dry- and wet-season surveys, no vernal pool fairy shrimp, vernal pool tadpole shrimp, or Conservancy fairy shrimp were detected, and the habitat was determined to be unsuitable for these species. There are no interrelated or interdependent activities related to the action that would affect terrestrial species.

5.6.1.1 Giant Garter Snake (GGS)

Habitat potentially suitable for Giant Garter Snake (GGS) is present at both gate locations and the Holland Tract Alternate Storage site. The Project site is within habitat designated for the recovery of the species (USFWS 1999), and GGS is assumed to be present. Construction of the Project has the potential to take individual snakes if they are present in the area subject to disturbance. GGS are active during the summer (season defined May 1 to September 30) and hibernate in upland burrows and refugia during the winter (season defined October 1 to April 30). Construction activities and site disturbance between May 1 and September 30 could result in the take of snakes during their active period, if present within the area subject to disturbance. Although unlikely, foraging, resting, or migrating GGS could be directly killed by vehicular traffic on the levee roads accessing the Project site, or by construction equipment within the Project site. Land-based disturbance would occur during initial construction in September (during the active season), and gate removal in 2014 would be conducted during the active period of GGS.

All site disturbance that has the potential to result in a take of GGS will be conducted during the active period for GGS between May 1 and September 30. Installation of the barge and gates during November would involve access along the roads, but would not impact GGS because there would be no earthmoving work that could disturb, expose or entomb GGS hibernating in upland refugia, and GGS would not be present above ground on roadways during this period.

Project construction may result in a temporary loss of habitat for GGS as upland refugia and burrows suitable for hibernation may be crushed by earthmoving equipment, and debris piles that function as upland refugia are removed from within the laydown areas to accommodate construction activities. The removal of emergent and riparian vegetation along the banks of Old River and Connection Slough, as well as the removal of upland vegetation within the construction zone could expose GGS to predation. The loss of upland refugia and vegetative cover within the Project construction zone would be short-term impacts as burrowing mammals would likely recolonize areas disturbed during construction, and vegetative cover would be quickly reestablished following disturbance. Furthermore, the 2-Gates Project is short-term by design, as it is intended to serve as a pilot project to test the effectiveness of these seasonally operated gates on the aquatic species of concern. The effects of the Project on GGS would occur principally during construction activities and the removal of the gates in 2014.

Gate operations are not expected to impact giant garter snakes or significantly impede their movement. The gates would be opened and closed over a period of approximately 10 minutes. The snakes are highly mobile and would be able to move away from the gates during operation, and around the sheet piles on the levees when the gates are closed.

5.6.1.2 Vernal Pool Fairy Shrimp, Vernal Pool Tadpole Shrimp, Conservancy Fairy Shrimp

As discussed in Sections 3.2.2-3.2.4, no listed large branchiopods were detected during wet- and dry-season surveys. Since the wetland never ponded water during any of the wet season site visits, the wetland basin was determined to be unsuitable for federally-listed large branchiopods. The wet- and dry-season reports are enclosed in Appendix J. Therefore the Project will have no effect on these species.

5.6.1.3 Swainson’s Hawk

Project activities are not expected to require the removal of any trees so no direct effects to Swainson’s hawk nesting habitat are anticipated. The project does not propose the conversion of agricultural fields that may be used by Swainson’s hawk for foraging to other uses. Thus, project activities are not expected to affect foraging habitat. . Installation of the Project facilities will not affect nesting activities of Swainson’s hawk because construction would occur outside of the nesting season (mid-March to late July). Removal of the gates and boat ramps during the in-water work window (July 1 through November 30) in 2014 would take place toward the end of the nesting season when young birds are active and nest abandonment due to construction disturbance is extremely unlikely, or after the nesting season. The potential for construction activities to adversely affect the reproductive success of a nest decreases with the distance between the nest and construction disturbance. The potential for adverse effects is high if construction directly impacts active nest trees while the potential for adverse effects is substantially reduced if construction activities are greater than 200 yards from an active nest.

Therefore, the project would not adversely affect the nesting behavior of Swainson's hawk.

5.6.1.4 California Black Rail, Tricolored Blackbird, and Loggerhead Shrike

Large and small trees on the Holland Tract, Old River site and on Mandeville Island are present either in or near the Project sites. These trees may serve as potential nesting sites for a variety of raptors, and other migratory birds. The study area also provides foraging habitat for a wide range of species. Suitable nesting habitat is present in the riparian scrub and the planted trees. Wetland habitats along the margins of Old River and Connection Slough may provide suitable habitat for the California black rail and tricolored blackbird.

Construction activities would not adversely affect the nesting activities of black rail, tricolored blackbird, or loggerhead shrike because land-based disturbance and removal activities would occur September through November, outside the nesting season. Gate removal in 2014 would require minimal land-based disturbance and would be conducted late in the nesting season or after the nesting season. The potential to disrupt nesting behavior of black rail and tricolored blackbird is also limited due to the small area of marsh habitat along the levees that would be disturbed by construction.

Gate operations would not adversely affect protected bird species. Nesting and foraging habitat would not be impacted by gate operations, since operations will not disturb those habitats, and birds nesting in proximity to the gates would presumably be habituated to ongoing operations since operations would begin prior to the nesting season for all species of concern. Gates would be open during flood events, producing less than a 0.1-foot change in flood stage elevations in a 100 year event, so the disturbance of low-lying nesting habitat is unlikely.

5.6.1.5 Burrowing Owl

Land-based construction activities, including the installation and removal of sheet piles, pile-supported boat ramps, clearing, grading, the storage or movement of rock or other construction materials, or disposal of dredge spoils could result in a direct take of individuals, if burrowing owls are present in the disturbance area. Construction activities would not result in failure of a nest because all earth-moving work will occur outside the breeding season. Gate operations would not adversely affect burrowing owls since the operations would not require land-based earthwork.

5.6.1.6 Western Pond Turtle

Western pond turtle (and the subspecies, northwestern pond turtle) has been documented to occur in the canal west of the Old River site on Holland Tract, on the channel islands north of the Old River study area, and to the south, on Old River. Western or northwestern pond turtles could be crushed or injured by construction equipment or vehicular traffic, if present within the Action Area during construction. Gate operations would not adversely affect these organisms since operations would not alter their habitat or involve actions that could pose a direct or indirect threat to these mobile animals.