Long-Term Operation of the California State Water Project

Addendum to the Final Environmental Impact Report (SCH No. 2023060467) To Modify Conditions of Approval 8.1.5, Collaborative Approach to Real-time Decision Making and 8.1.6, Real-time Information Sharing Process under Incidental Take Permit No. 2081-2023-054-00

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November 2025

ICF. 2025. *Addendum to the Final Environmental Impact Report (SCH No. 2023060467) to Modify Conditions of Approval 8.1.5, Collaborative Approach to Real-time Decision Making, and 8.1.6, Real-time Information Sharing Process, Under Incidental Take Permit No. 2081-2023-054-00*. November. (ICF 104469.0.014.) Sacramento, CA. Prepared for California Department of Water Resources, Sacramento, CA.

Contents

Tables

Figures

Acronyms and Abbreviations

Term	Definition
°C	degrees Celsius
BiOp	biological opinion
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cHAB	cyanobacteria harmful algal bloom
CVP	Central Valley Project
D-1641	Decision 1641
DCG	Delta Coordination Group
Delta	Sacramento–San Joaquin Delta
DSM2	Delta Salinity Model II
DWR	California Department of Water Resources
EDSM	Enhanced Delta Smelt Monitoring Program
EIR	environmental impact report
FEIR	final environmental impact report
ITP	incidental take permit
km	kilometer
mm	millimeter
NDOI	Net Delta Outflow Index
NTU	Nephelometric Turbidity Unit
P. forbesi	*Pseudodiaptomus forbesi*
ppt	parts per thousand
psu	practical salinity unit
Reclamation	U.S. Bureau of Reclamation
Rkm	river kilometer
SCHISM	Semi-Implicit Cross-scale Hydroscience Integrated System Model
SMSCG	Suisun Marsh Salinity Control Gates
Summer-Fall Action	Delta Smelt Summer-Fall Habitat Action
SWP	State Water Project
TAF	thousand acre-feet
USFWS	U.S. Fish and Wildlife Service
WY	water year

Chapter 1
Introduction and Purpose

1.1 Introduction

The California Department of Water Resources (DWR, permittee) is submitting a Minor Amendment Request to the California Department of Fish and Wildlife (CDFW) for its incidental take permit (ITP) for the Long-Term Operations of the California State Water Project (SWP) (California Department of Fish and Wildlife 2024; Permit No. 2081-2023-054-00). The ITP, referred to hereafter as the 2024 LTO ITP, was issued in 2024 and provides incidental take coverage for the effects of SWP operations on five fish species listed under the California Endangered Species Act (CESA) — Longfin Smelt (*Spirinchus thaleichthys*), Delta Smelt (*Hypomeus transpacificus*), winter-run Chinook Salmon (*Oncorhynchus tshawytscha*), spring-run Chinook Salmon (*O. tshawytscha*), and White Sturgeon (*Acipenser transmontanus*) in: (1) the Sacramento River from its confluence with the Feather River downstream to the legal Sacramento–San Joaquin Delta (Delta) boundary at the I Street Bridge in the city of Sacramento; (2) the Delta (i.e., upstream to Vernalis and downstream to Chipps Island); and (3) Suisun Marsh and Bay (see Figure 1-1). Collectively, these species are referred to as covered species. This request is DWR's second request for an amendment to ITP 2081-2023-054-00.

This Environmental Impact Report (EIR) Addendum provides California Environmental Quality Act (CEQA) coverage for DWR's request for a Minor Amendment (Amendment 2) to the 2024 LTO ITP, in which DWR requests to modify Conditions of Approval (COA) 8.1.5, *Collaborative Approach to Real-time Decision Making,* and 8.1.6, *Real-time Information Sharing Process*, which in turn, would also modify COAs 8.3.1*, First Flush Action*, 8.3.2, *Adult Delta Smelt Entrainment Protection Action*, and 8.4.1, *Larval and Juvenile Delta Smelt Protection Action*.

DWR has prepared this Addendum for the proposed changes to ITP COAs 8.1.5 and 8.1.6, which in turn would affect three of the Delta Smelt Actions [COAs 8.3.1, 8.3.2, 8.4.1], to comply with CEQA (Pub. Resources Code, § 21000 et seq.), augmenting the 2024 *Final Environmental Impact Report for Long-Term Operations of the State Water Project* (2024 FEIR) (California Department of Water Resources 2024, State Clearinghouse No. 2023060467). As described in this Addendum, the proposed revisions to the 2024 LTO ITP do not require revisions to the conclusions or findings presented in the 2024 FEIR because no new or substantially more intense or severe significant environmental impacts or potentially significant environmental impacts would occur.

1.1.1 Summary of Proposed Project Description Updates

DWR is proposing an alternative decision-making approach to the collaborative approach described in the FEIR in section 2.3.3.2, Start of OMR Management, subsections of 2.3.3. Real-Time Adjustments, including Adult Delta Smelt Entrainment Protection Action and Larval and Juvenile Delta Smelt Protection Action, and section 2.3.22 Governance, subsection 2.3.22.4, Delta (2024 LTO ITP COAs 8.5.1 and 8.6.1, which in turn would affect three of the Delta Smelt Actions [COAs 8.3.1, 8.3.2, 8.4.1]). The proposed modifications include the following:

- The First Flush Action, Adult Delta Smelt Entrainment Protection Action (Turbidity Bridge) and Larval and Juvenile Longfin Smelt Protection Action will be added to the list of SWP management actions that are subject to assessment.
    - Assessments will propose operational adjustments within boundaries no more negative than -5,000 cfs OMR.
    - Assessments will include an evaluation of impacts to covered species by proposed operations, informed by available quantitative tools and real-time data, which may include entrainment and routing, modeling, distribution, and other real-time data, as appropriate.
- Allow real-time assessment for Delta Smelt winter and spring entrainment protection actions.
    - DWR will provide an assessment framework that considers covered species impacts.
    - DWR will develop a science plan to improve understanding of Delta Smelt and salmonid movement and migration behaviors during the OMR flow period that will inform the real-time assessment framework of OMR flow management for Delta Smelt and Salmon and develop new operational conditions by 2029.

No changes to SWP facilities or other operations are proposed.

1.1.2 Proposed Updates to Conditions of Approval 8.1.5 and 8.1.6

DWR is proposing to modify OMR management actions to improve SWP operational flexibility while maintaining a similar or equal level of protection as the 2024 ITP, particularly in consideration of Governor Newsom's Executive Order N-16-25, and the status of the supplemented Delta Smelt population. Monitoring data suggests that the majority, if not all, of Delta Smelt detected in recent years are of hatchery ancestry. There are large uncertainties around the behavior of supplemented Delta Smelt, including the degree to which they are spawning and recruiting, and if the migratory behavior and habitat preferences (e.g., responses to turbidity) of supplemented smelt are similar to the historical population. DWR proposes to modify OMR management actions by modifying COA 8.1.5, Collaborative Approach to Real-time Decision Making, and COA 8.1.6, Real-time Information Sharing Process, which in turn, would also modify COAs 8.3.1, First Flush Action, 8.3.2, Adult Delta Smelt Entrainment Protection Action, and 8.4.1, Larval and Juvenile Delta Smelt Protection Action.

1.1.2.1 Proposed Condition of Approval Modifications to COA 8.1.5 and 8.1.6

Proposed modification of COA 8.1.5 and 8.1.6 includes changing the collaborative technical team approach and information sharing process for Delta Smelt actions (8.3.1, 8.3.2, and 8.4.1) to implementing OMR management actions (i.e., limiting OMR flows to -5,000 cfs) based on a suite of real-time assessments that: (1) identify whether Delta Smelt are present within the zone of influence of the Harvey O. Banks Pumping Plant; and (2) whether increasing exports to maintain OMR no more negative than -5,000 cfs would result in increased entrainment of Delta Smelt, relative to levels evaluated in the 2024 ITP. Proposed assessments include an evaluation of impacts to covered species informed by available quantitative tools and real-time data, which may include estimates of entrainment and routing, real-time modeling, species distribution, and other real-time data, as appropriate. The proposed OMR management actions will maintain a similar or equal level of protection as the existing OMR management actions included in the 2024 ITP (California Department of Fish and Wildlife 2024). DWR is not proposing any changes to the real-time elevation process as described in 8.1.5, reiterating that CDFW's Director retains final decision authority on elevation items brought forward by WOMT members.

Updated Decision-making Approach to Delta Smelt Actions (COAs 8.3.1, 8.3.2, and 8.4.1)

Condition 8.3.1, First Flush Action

Proposed modification of COA 8.3.1 includes changing the OMR index range of no more negative than -2,000 cfs to no more negative than -5,000 cfs. The rest of the requirements of the First Flush Action will remain the same. Proposed assessments to determine the operational parameters of the First Flush Action include an evaluation of impacts to covered species informed by available quantitative tools and real-time data, which may include estimates of entrainment and routing, real-time modeling, species distribution, and other real-time data, as appropriate. The proposed OMR management actions will maintain a similar or equal level of protection as the existing OMR management actions included in the 2024 ITP (California Department of Fish and Wildlife 2024)

In the event that real-time physical and biological conditions indicate that adult Delta Smelt are not moving upstream into the south Delta or otherwise subject to entrainment risk, DWR may propose an assessment for CDFW to consider for alternative implementation of the action.

Condition 8.3.2, Adult Delta Smelt Entrainment Protection Action

Proposed modification of COA 8.3.2 includes changing the OMR index range from no more negative than -3,500 cfs to no more negative than -5,000 cfs. The rest of the requirements of the Adult Delta Smelt Entrainment Protection Action will remain the same. Proposed assessments to determine the operational parameters of the Adult Delta Smelt Entrainment Protection Action include an evaluation of impacts to covered species informed by available quantitative tools and real-time data, which may include estimates of entrainment and routing, real-time modeling, species distribution, and other real-time data, as appropriate. The proposed OMR management actions will maintain a similar or equal level of protection as the existing OMR management actions included in the 2024 ITP (California Department of Fish and Wildlife 2024), as well as maintaining alignment between SWP and CVP export operations.

In the event that real-time physical and biological conditions indicate that adult Delta Smelt are not moving upstream into the south Delta or otherwise subject to entrainment risk, DWR may propose an assessment for CDFW to consider for alternative implementation of the action.

Condition 8.4.1, Larval and Juvenile Delta Smelt Protection Action

Proposed modification of COA 8.4.1 includes changing the OMR index range from no more negative than -3,500 cfs to no more negative than-5,000 cfs when the average Secchi disk depth in the most recent survey is less than 1 meter. The rest of the requirements of the Larval and Juvenile Delta Smelt Protection Action will remain the same. Proposed assessments to determine the operational parameters of the Larval and Juvenile Delta Smelt Protection Action include an evaluation of impacts to covered species informed by available quantitative tools and real-time data, which may include estimates of entrainment and routing, real-time modeling, species distribution, and other real-time data, as appropriate. The proposed OMR management actions will maintain a similar or equal level of protection as the existing OMR management actions included in the 2024 ITP (California Department of Fish and Wildlife 2024), as well as maintaining alignment between SWP and CVP export operations.

In the event that real-time physical and biological conditions indicate that Delta Smelt are not successfully propagating from adult releases or otherwise not subject to entrainment risk, DWR may propose an assessment for CDFW to consider for alternative implementation of the action.

1.2 Background

CDFW approved the 2024 LTO ITP on November 04, 2024, for the potential take of five CESA-listed fish species associated with the long-term operation of the SWP facilities in the Delta. DWR's Notice of Determination for the 2024 FEIR, prepared to support the ITP, was filed with the State Clearinghouse on October 28, 2024.

The 2024 FEIR evaluated five alternatives, including the No Project Alternative and Proposed Project. The Proposed Project includes a suite of operations-related elements to minimize impacts on aquatic species and additional actions to benefit CESA-listed fish species in the Delta.

In August 2025, DWR requested an amendment to the 2024 ITP and prepared an addendum to the 2024 FEIR to evaluate modifications to the Fall X2 requirement and Suisun Marsh Salinity Control Gate operations described in sections 2.3.6.1 and 2.3.6.2 of the FEIR. DWR filed the EIR Addendum with the California Office of Land Use and Climate Innovation, State Clearinghouse on August 26, 2025. CDFW issued Amendment 1 to the 2024 ITP (No. 2081-2023-054-00) on September 29, 2025.

DWR submitted proposed Amendment 2 to CDFW on November 18, 2025, which proposed to update the 2024 ITP governance COAs 8.5.1 and 8.6.1, which in turn would update implementation of specific Delta Smelt protection actions (ITP COAs 8.3.1, 8.3.2). These COAs are described in the FEIR in section 2.3.3.2, *Start of OMR Management*, subsections of 2.3.3. *Real-Time Adjustments*, including *Adult Delta Smelt Entrainment Protection Action* and *Larval and Juvenile Delta Smelt Protection Action*, and section 2.3.22 *Governance*, subsection 2.3.22.4, *Delta*.

All other provisions of the 2024 LTO ITP would remain in effect, and all operations would continue to comply with applicable laws, contractual obligations, and agreements. All provisions in the amended 2024 LTO ITP and operation of the SWP will continue to protect the five species covered

under the 2024 LTO ITP after the proposed revisions to the ITP are accepted by CDFW and the ITP is amended.

1.3 Purpose of the Environmental Impact Report Addendum

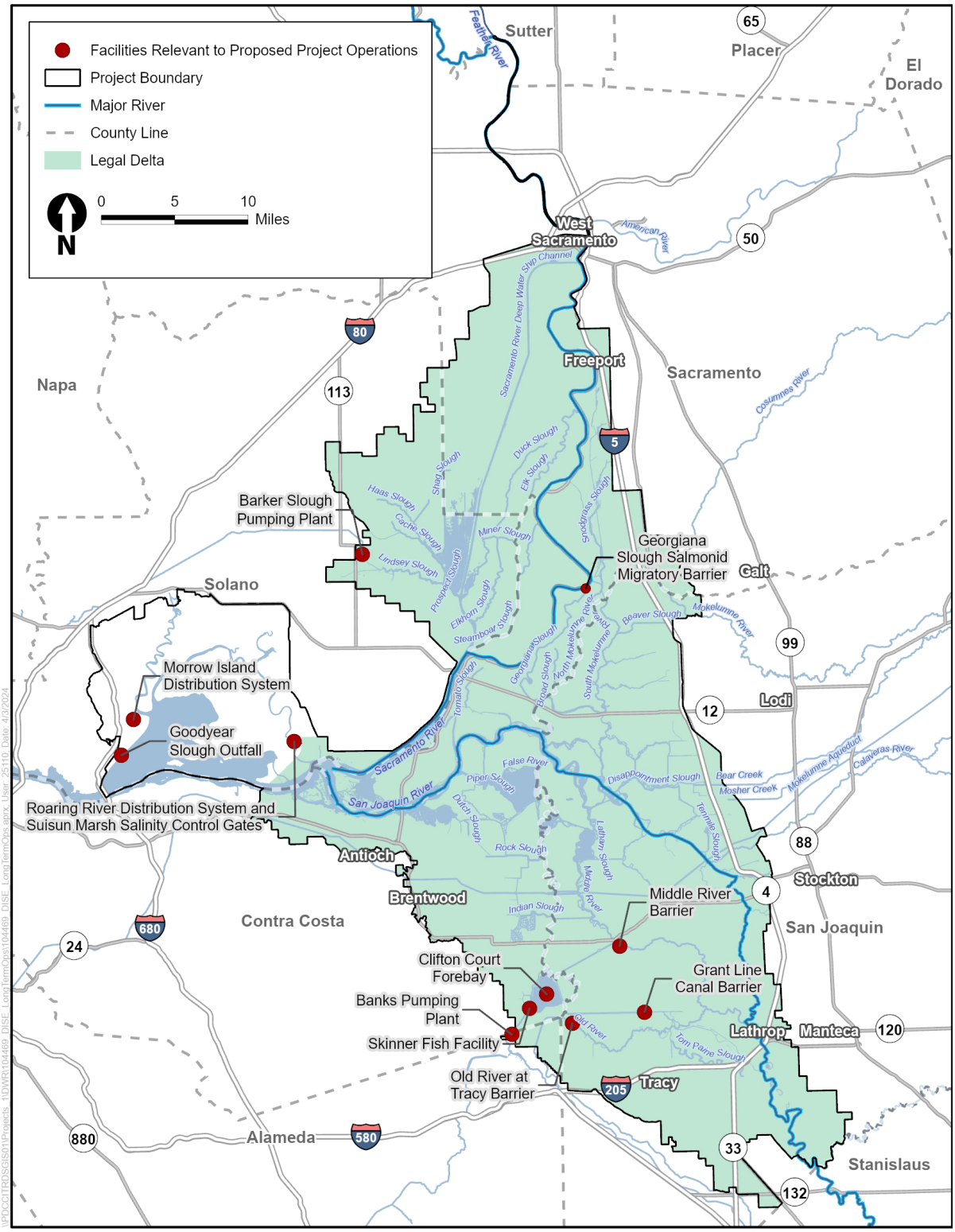
According to Section 15164(a) of the CEQA Guidelines, the lead agency or a responsible agency shall prepare an addendum to a previously certified EIR if some changes or additions are necessary but none of the conditions described in Section 15162 requiring preparation of a subsequent EIR have occurred. Section 15162 of the CEQA Guidelines lists the conditions that would require the preparation of a subsequent EIR rather than an addendum. These include the following:

1. Substantial changes are proposed in the project which will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects;
2. Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects; or
3. New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time of the previous EIR was certified as complete or the negative declaration was adopted, shows any of the following:
    a. The project will have one or more significant effects not discussed in the previous EIR or negative declaration;
    b. Significant effects previously examined will be substantially more severe than shown in the previous EIR;
    c. Mitigation measures or alternatives previously found not to be feasible would in fact be feasible, and would substantially reduce one or more significant effects of the Project, but the project proponents decline to adopt the mitigation measure or alternative; or
    d. Mitigation measures or alternatives which are considerably different from those analyzed in the previous EIR would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.

This Addendum concludes that the proposed changes to COAs 8.1.5 and 8.1.6 of the 2024 LTO ITP does not trigger any of the CEQA Guidelines Section 15162 conditions described above. The proposed changes to the ITP do not require revisions to the conclusions or findings presented in the 2024 FEIR because no new or substantially more intense, severe significant environmental impacts, or potentially significant environmental impacts would occur.

The level of protection for the five covered species, as well as other aquatic species evaluated in the 2024 FEIR will not change as a result of the requested amendment to COAs 8.1.5 and 8.1.6 of the 2024 LTO ITP. The requested amendment to COAs 8.1.5 and 8.1.6 would also modify the decision-making approach for Delta Smelt Actions 8.3.1, 8.3.2, and 8.4.1 as described in Section 1.1.2,

Proposed Updates to Condition of Approval Modifications to COA 8.1.5 and 8.1.6. DWR does not propose changes to any other ITP conditions.



Source: California Department of Water Resources 2024.

Figure 1-1. Locations of Facilities Relevant to Proposed Project Operations in the Delta, Suisun Marsh, and Suisun Bay

Chapter 2
Environmental Review

2.1 Summary of Previous Environmental Review Process

The effects on the environment of long-term operations of the SWP facilities in the Delta and issuance of an ITP to provide incidental take coverage for five CESA-listed fish species were addressed in the 2024 FEIR.

The analyses presented in the 2024 FEIR concluded that the Proposed Project and the alternatives considered would have either no impact or a less-than-significant impact on the environment, depending on the resource category evaluated (e.g., DWR identified no impact on Aesthetics and less-than-significant impacts on Aquatic Biological Resources; see Appendix 3A and Chapter 6 of the 2024 FEIR). DWR selected the Proposed Project as the long-term operations of the SWP.

Further, the Proposed Project included measures to meet the legal standard under CESA to minimize and fully mitigate the take of listed species consistent with DWR's application for an ITP. The Proposed Project provides flow management in Old and Middle rivers to minimize entrainment into the SWP pumping facilities; freshwater outflow in the spring, summer, and fall; and other actions to benefit CESA-listed fish species. The Proposed Project is expected to better protect CESA-listed and other special-status aquatic species than historical operations.

The Proposed Project was determined to have no impacts or less-than-significant impacts on all environmental resources evaluated and includes measures that minimize and fully mitigate impacts on CESA-listed fish species. Therefore, the long-term operation of the SWP and issuance of the ITP:

1. Will not degrade environmental quality, substantially reduce habitat, cause a wildlife population to drop below self-sustaining levels, reduce the number or restrict the range of special-status species, or eliminate important examples of California history or prehistory.
2. Does not have the potential to achieve short-term environmental goals to the disadvantage of long-term environmental goals.
3. Will not have impacts that are individually limited but cumulatively considerable.
4. Will not have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly.

The environmental analyses and findings presented in the 2024 FEIR reflect the independent judgment of DWR as the lead agency under CEQA.

2.2 Environmental Analysis

This section of the addendum analyzes the potential effects on the physical environment from implementing the proposed change to the *Collaborative Approach to Real-time Decision Making* (ITP COA 8.1.5) and *Real-time Information Sharing Process* (ITP COA 8.1.6). This analysis has been prepared to determine whether any of the conditions in Section 15162 or 15163 of the State CEQA Guidelines (as described in Section 1.3, *Purpose of the Environmental Impact Report Addendum*) would occur as a result of the proposed minor revisions to the ITP.

2.2.1 Topics Considered in This Addendum

The proposed changes are described in detail in Section 1.1.2, *Updates to Condition of Approval Modifications to COA 8.1.5 and 8.1.6,* and would modify the Collaborative Approach to Real-time Decision Making (ITP COA 8.1.5) and the Real-time Information Sharing Process (ITP COA 8.1.6) specifically related to Delta Smelt Actions 8.3.1, 8.3.2, and 8.4.1 adding these COAs to the list of COAs that are subject to assessment. Assessments will propose operational adjustments within boundaries no more negative than -5,000 cfs OMR. Assessments will include an evaluation of impacts of SWP operations to CESA-listed species (i.e., those included in the 2024 ITP), informed by available quantitative tools and real-time data, which may include entrainment and routing impacts, modeling, distribution, and other real-time data, as appropriate.

These proposed changes would not substantially modify the actions evaluated in the 2024 FEIR. Therefore, the proposed changes would not result in new significant impacts or a substantial increase in the intensity or severity of environmental effects for any of the following topic areas:

- Aesthetics
- Agriculture/Forestry Resources
- Air Quality
- Biological Resources
- Cultural Resources
- Energy
- Geology/Soils
- Greenhouse Gas Emissions
- Growth Inducement
- Hazards and Hazardous Materials
- Hydrology/Water Quality
- Land Use/Planning
- Mineral Resources
- Noise
- Population/Housing
- Public Services
- Recreation
- Transportation
- Tribal Cultural Resources
- Utilities/Service Systems
- Wildfire
- Environmental Justice
- Climate Change Resiliency and Adaptation

Additional analysis on aquatic biological resources related to the proposed change is provided in the analysis below.

2.2.2 Analysis of Effects on CESA-Listed Fish Species of Management Concern

2.2.2.1 Updated Decision-Making Approach to First Flush Action

Quantitative Hydrological Scenarios

To illustrate potential effects of the different OMR scenarios that could occur under the updated decision-making approach to the First Flush Action, hydrological scenarios were developed for the 2011, 2012, and 2013 Water Years (WY), representing a Wet, Below Normal, and Dry year, respectively, that varied the First Flush Action OMR target between -2,000 cfs, -3,500 cfs, and -5,000 cfs. Delta inflow boundary conditions were kept the same between scenarios. A summary of key variables is provided in Table SUM1. Operations for each of the OMR scenarios reflects other operational criteria (e.g., D-1641) as they currently exist, in tandem with the 2024 ITP.

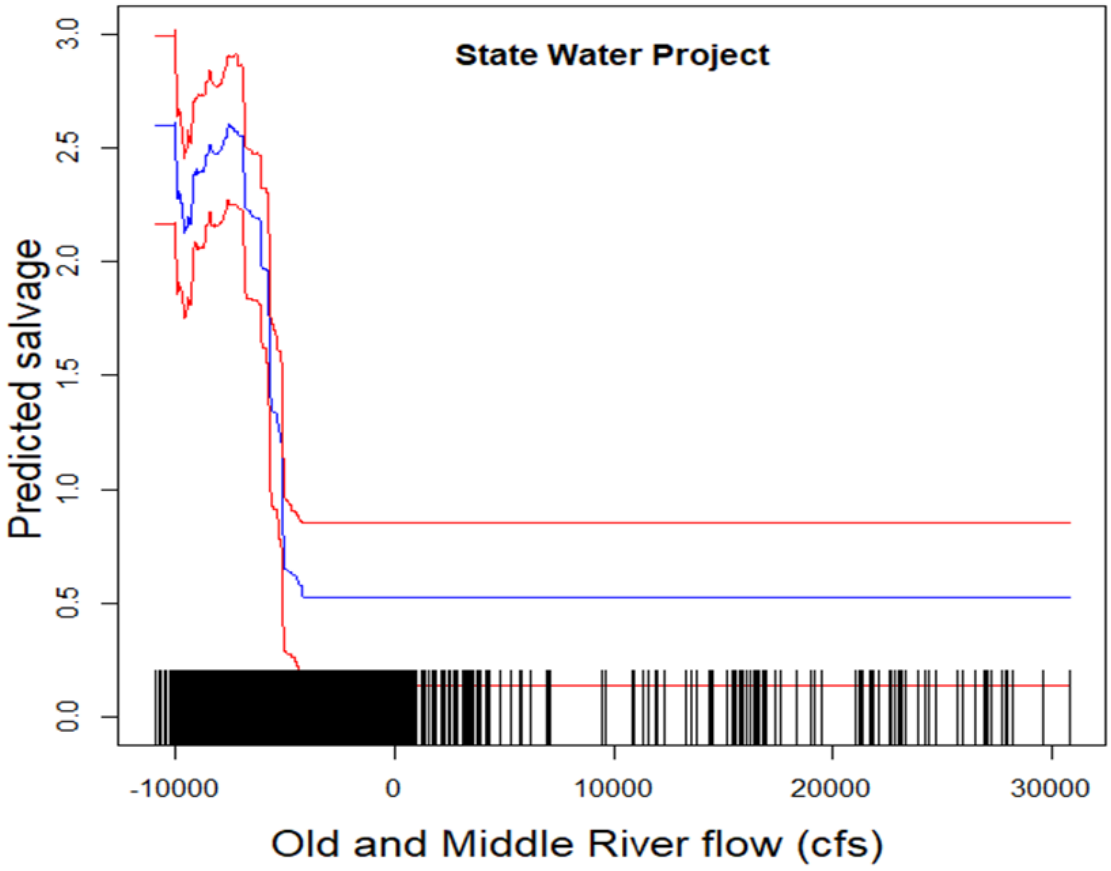
Table SUM1. Summary of Mean Monthly Hydrological Outputs (cfs) for the Three Illustrative Water Years, By OMR Scenario.

Water Year (Date of First Flush Trigger)	Month	Sacramento River at Freeport (all scenarios)	San Joaquin River at Vernalis (all scenarios)	Banks Export			Jones Export			QWEST			Delta Outflow		
				-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
2011 (12/17/2010)	Dec	33,421	6,944	4,611	5,208	5,904	4,006	4,153	4,200	8,998	8,255	7,511	46,348	45,605	44,861
	Jan	30,116	11,788	7,364	7,364	7,364	4,200	4,200	4,200	8,762	8,762	8,762	40,017	40,017	40,017
	Feb	21,978	8,700	5,540	5,540	5,540	4,200	4,200	4,200	5,438	5,438	5,438	26,557	26,557	26,557
	Mar	43,602	13,672	6,361	6,361	6,361	4,200	4,200	4,200	19,091	19,091	19,091	98,695	98,695	98,695
2012 (1/25/2012)	Dec	12,442	1,817	4,934	4,934	4,934	4,152	4,152	4,152	-5,682	-5,682	-5,682	5,691	5,691	5,691
	Jan	13,320	1,821	2,138	2,265	2,393	3,206	3,398	3,589	-298	-616	-935	12,066	11,748	11,429
	Feb	11,689	1,585	1,379	1,426	1,522	2,069	2,139	2,283	610	492	253	11,514	11,396	11,157
	Mar	18,704	1,615	1,958	1,945	1,934	2,937	2,918	2,901	1,557	1,590	1,618	17,910	17,942	17,971
2013 (12/3/2012)	Dec	41,003	1,960	2,397	2,695	2,995	2,625	3,072	3,521	7,184	6,438	5,690	51,328	50,583	49,835
	Jan	20,597	1,840	2,399	2,399	2,399	3,598	3,598	3,598	239	239	239	21,277	21,277	21,277
	Feb	13,664	2,229	2,239	2,239	2,239	3,358	3,358	3,358	-502	-502	-502	12,346	12,346	12,346
	Mar	11,922	1,510	1,556	1,556	1,556	2,334	2,334	2,334	-38	-38	-38	10,806	10,806	10,806

Delta Smelt

The December–February time period of the First Flush Action coincides with the main December–March adult Delta Smelt upstream migration period of entrainment risk, whereas larval/early juvenile presence and entrainment risk is during the March–June period (ICF 2023:4-3–4-6) after the First Flush Action. This analysis therefore focuses on potential take and effects to adult Delta Smelt.

Grimaldo et al. (2021) assessed the relative influence of various predictors on adult Delta Smelt daily salvage during December–March from 1993 to 2016. Smith (pers. comm.) recreated the original Grimaldo et al. (2021) model predictions plot (Figure 3 from publication) using the first flush salvage dataset and found predicted salvage remains at a low baseline at OMR flows more positive than -5,000 cfs but rapidly increases at OMR flows more negative than -5,000 cfs (Figure DS1).



Source: Smith (pers comm), using the first flush salvage dataset and Boosted Regression Tree (BRT) methods outlined in Grimaldo et al. (2021). Note: Vertical axis is predicted daily salvage (number of adult Delta Smelt) during December 1 to the date when daily cumulative salvage reached its 50th percentile for the season and horizontal axis is mean OMR flow in cfs.

Figure DS1. Relationship of Daily SWP South Delta Salvage of Adult Delta Smelt to Mean Old and Middle River (OMR) Flow, December 1 to the date that daily cumulative salvage reached its 50th percentile.

To assess the potential differences in take and effects to adult Delta Smelt from different OMR levels that could be applied under the updated decision-making approach to the First Flush Action, particle tracking for particles with adult Delta Smelt swimming behavior was undertaken with the RMA Bay-Delta Model. The swimming behavior assumed was "Tidal migration when perceived salinity is increasing, holding in turbid water" (abbreviated to TpsHt) developed by Gross et al. (2021). The main elements of this behavior are:

- Perform tidal migration for 24 hours when there is a perceived increase in salinity >0.5 PSU, with tidal migration as follows:
    - Migrate laterally with the tides by swimming at 8 cm per second toward shallower water during ebb tide and toward deeper water during flood tide.
    - Behave as passive particles within 10 meters of the shoreline during ebb tide.
- When not performing tidal migration, perform holding behavior by swimming toward shallow water during ebb tide when turbidity is >12 NTU and local depth is >4 meters.

For each First Flush Action OMR scenario (i.e., -2,000 cfs, -3,500 cfs, and -5,000 cfs), particles were inserted on the day that the First Flush Action triggered (i.e., 12/17/2010 for WY 2011; 1/25/2012 for WY 2012; and 12/3/2012 for WY 2013). Particles were inserted at Chipps Island (to represent a typical starting location for upstream migration from the low salinity zone) and evenly across a portion of the north Delta (to represent a supplementation release in Shag Slough at Lookout Slough several days/weeks before first flush, and subsequent dispersal; Figure DS2). Particles were released at a 15-minute interval over a 12-hour period (0600 – 1800) on the first simulation day, with particles tracked for 90 days. The RMA Bay-Delta Model simulated electrical conductivity (EC) and turbidity to facilitate particle expression of the TpsHt migration behavior. Various particle fates were tracked weekly, i.e., movement downstream past Chipps Island, unresolved particles in the south Delta/OMR corridor, upstream past Emmaton/Decker Island, upstream past Jersey Point, downstream past Rio Vista, flux through Threemile Slough, and entrainment at SWP and CVP south Delta export facilities (Figure DS2).

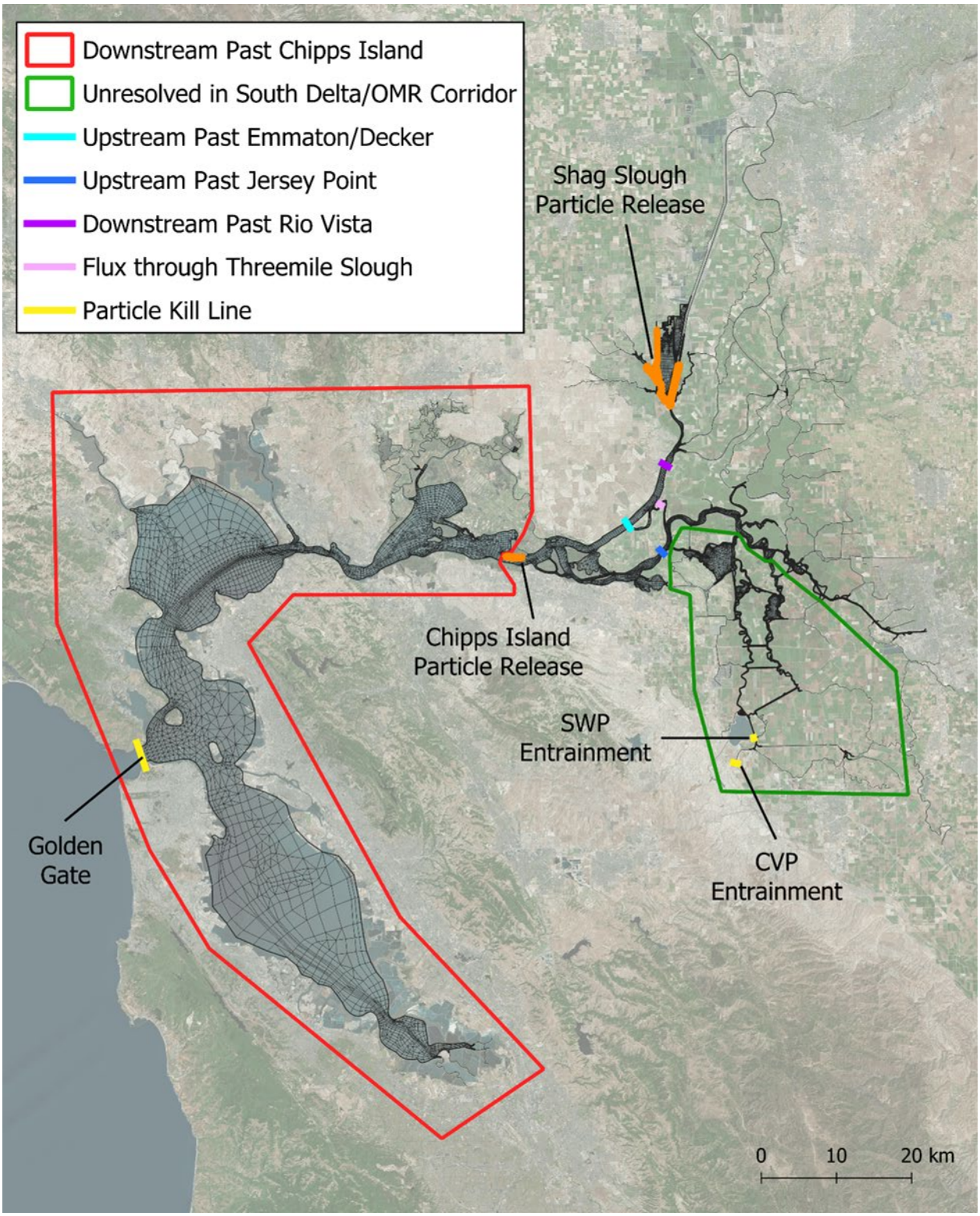


Figure DS2. RMA Bay-Delta Model Domain with Particle Insertion Locations and Fates Tracked for the Adult Delta Smelt Particle Tracking Modeling.

The results of the adult Delta Smelt particle tracking analysis showed that there was minimal risk of south Delta entrainment or of particles being left unresolved in the south Delta/OMR corridor during the wet WY of 2011 (Tables DS1 and DS2). Absolute entrainment in the south Delta was higher in WY 2012 and WY 2013 than WY 2011, as would be expected with the drier hydrological conditions in WY 2012 and WY 2013, but the absolute entrainment of particles was still relatively low (ultimately around 2–3% of particles were entrained at each facility by the end of tracking period, for both the Chipps Island and Shag Slough releases; Tables DS3–DS6). Entrainment was generally greater for the scenarios with more negative OMR, but the differences were not large. Notably, the effect of changes in OMR flows on particle fates at most flux points is generally negligible, with release location and water year type having a larger effect. As these model runs were structured to highlight the relative effect of OMR flow, while keeping all other variables constant, the minor differences among OMR scenarios within each release location by water year combination are evident. The differences in particle fates that do appear are highest during the First Flush Action period and become muted with time afterwards, which is logical given operations are identical[1] among scenarios following the end of the First Flush Action period.

[1] The exception is following the First Flush Action in mid-late February of WY 2012, when the hydrological modeling included a period of higher exports under the -2,000-cfs OMR scenario than the other scenarios, reflecting operations being less constrained to meet Delta X2 criteria under that scenario because of the earlier restriction during the First Flush Action.

Table DS1. Adult Delta Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%) Inserted at Chipps Island, Water Year 2011.

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Upstream past Emmaton/Decker			Upstream past Jersey Point			Downstream past Rio Vista			Flux through Threemile Slough			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
12/24/2010	0.0	0.0	0.0	0.0	0.0	0.0	99.1	98.8	98.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/31/2010	0.0	0.0	0.0	0.0	0.0	0.0	99.6	99.4	99.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1/7/2011	0.0	0.0	0.0	0.0	0.0	0.0	99.5	99.3	99.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1/14/2011	0.0	0.0	0.0	0.0	0.0	0.0	99.5	99.4	99.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1/21/2011	0.0	0.0	0.0	0.0	0.0	0.0	96.2	95.9	96.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1/28/2011	0.0	0.0	0.0	0.0	0.0	0.0	91.2	91.0	91.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2/4/2011	0.0	0.0	0.0	0.0	0.0	0.0	84.4	84.3	84.3	0.2	0.2	0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0
2/11/2011	0.0	0.0	0.0	0.0	0.0	0.0	70.5	70.1	70.1	0.2	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.0	0.0
2/18/2011	0.0	0.0	0.0	0.0	0.0	0.0	65.9	65.6	65.7	2.6	2.2	2.5	1.8	1.8	1.8	-0.1	-0.1	-0.1	0.9	1.0	1.0	0.8	0.8	0.8
2/25/2011	0.1	0.0	0.1	0.0	0.0	0.0	74.3	74.2	74.1	2.1	1.9	1.9	-0.8	-0.8	-0.6	-0.1	-0.1	-0.1	1.8	1.7	1.5	0.3	0.3	0.4
3/4/2011	0.2	0.1	0.2	0.0	0.0	0.0	80.0	80.1	79.3	2.2	2.0	1.9	-1.1	-1.2	-1.0	-0.1	-0.1	-0.1	2.0	1.8	1.8	0.3	0.3	0.3
3/11/2011	0.2	0.2	0.2	0.0	0.0	0.0	84.5	85.0	84.1	2.2	1.9	1.9	-1.4	-1.3	-1.2	-0.1	-0.1	-0.1	2.1	1.9	1.8	0.2	0.2	0.2
3/18/2011	0.3	0.2	0.2	0.0	0.1	0.0	91.1	91.9	91.1	2.2	1.9	1.9	-1.5	-1.4	-1.3	-0.1	-0.1	-0.1	2.1	1.9	1.8	0.2	0.1	0.2
3/25/2011	0.3	0.3	0.3	0.0	0.1	0.1	96.6	96.7	96.4	2.2	1.9	1.9	-1.6	-1.4	-1.3	0.0	0.0	-0.1	2.1	1.9	1.8	0.1	0.1	0.1

Table DS2. Adult Delta Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%) Inserted at Shag Slough, Water Year 2011.

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Upstream past Emmaton/Decker			Upstream past Jersey Point			Downstream past Rio Vista			Flux through Threemile Slough			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
12/24/2010	0.0	0.0	0.0	0.0	0.0	0.0	9.7	9.1	9.1	-21.6	-21.6	-21.2	-1.9	-1.8	-2.0	24.3	24.2	24.1	2.2	2.2	2.4	0.2	0.2	0.2
12/31/2010	0.0	0.0	0.1	0.0	0.0	0.0	15.8	15.8	15.3	-27.5	-27.6	-27.0	-2.3	-2.3	-2.7	30.1	30.3	30.2	2.5	2.5	3.0	0.1	0.1	0.1
1/7/2011	0.0	0.1	0.1	0.0	0.0	0.0	17.7	18.1	17.8	-28.2	-28.4	-27.8	-2.3	-2.4	-2.9	31.1	31.2	31.2	2.5	2.6	3.1	0.1	0.1	0.1
1/14/2011	0.1	0.1	0.1	0.0	0.0	0.0	20.7	21.4	20.9	-32.7	-32.8	-32.3	-2.5	-2.6	-3.0	36.3	36.4	36.3	2.9	2.9	3.3	0.1	0.0	0.0
1/21/2011	0.1	0.1	0.1	0.0	0.0	0.0	20.8	21.4	21.0	-33.2	-33.3	-32.7	-2.8	-2.9	-3.4	37.1	37.1	37.1	3.2	3.1	3.7	0.1	0.1	0.1
1/28/2011	0.1	0.1	0.1	0.0	0.0	0.0	19.0	19.6	19.2	-33.4	-33.6	-32.9	-3.2	-3.2	-3.7	37.7	37.8	37.8	3.6	3.5	4.1	0.1	0.1	0.1
2/4/2011	0.1	0.1	0.1	0.0	0.0	0.0	18.1	18.8	18.4	-37.9	-38.3	-37.7	-3.7	-3.7	-4.3	43.2	43.6	43.5	4.4	4.3	4.9	0.2	0.2	0.2
2/11/2011	0.1	0.1	0.2	0.0	0.0	0.0	16.2	16.7	16.5	-39.2	-39.5	-38.8	-3.9	-3.8	-4.4	44.0	44.3	44.1	4.5	4.5	5.0	0.2	0.2	0.2
2/18/2011	0.1	0.1	0.2	0.0	0.0	0.0	15.3	15.6	15.7	-37.5	-37.7	-37.2	-2.4	-2.3	-2.7	44.5	44.7	44.6	5.4	5.3	5.9	0.9	1.0	1.0
2/25/2011	0.2	0.2	0.2	0.1	0.0	0.0	21.7	21.6	21.9	-38.2	-38.4	-38.0	-4.9	-4.7	-5.4	44.7	44.9	44.8	6.2	6.2	6.6	0.4	0.5	0.5
3/4/2011	0.4	0.3	0.3	0.1	0.0	0.0	26.6	26.7	27.1	-38.2	-38.4	-37.9	-5.2	-5.3	-5.6	44.7	44.9	44.8	6.4	6.4	6.8	0.3	0.3	0.4
3/11/2011	0.4	0.4	0.4	0.1	0.1	0.0	30.8	30.8	31.0	-38.3	-38.4	-38.0	-5.5	-5.5	-5.8	44.7	44.9	44.9	6.4	6.5	6.8	0.2	0.2	0.2
3/18/2011	0.5	0.5	0.5	0.1	0.1	0.1	37.2	37.1	36.8	-38.9	-39.0	-38.6	-5.6	-5.6	-5.9	45.5	45.6	45.7	6.5	6.5	6.9	0.2	0.2	0.2
3/25/2011	0.6	0.6	0.6	0.1	0.1	0.1	43.4	43.3	43.3	-42.0	-41.9	-41.7	-6.0	-6.0	-6.3	49.1	49.0	49.2	6.9	7.0	7.3	0.1	0.1	0.1

Table DS3. Adult Delta Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%) Inserted at Chipps Island, Water Year 2012.

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Upstream past Emmaton/Decker			Upstream past Jersey Point			Downstream past Rio Vista			Flux through Threemile Slough			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
2/1/2012	0.0	0.0	0.0	0.0	0.0	0.0	82.9	80.6	78.3	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2/8/2012	0.0	0.0	0.0	0.0	0.0	0.0	56.0	53.3	49.9	3.4	4.1	5.3	1.8	2.6	4.0	0.0	-0.1	-0.1	0.4	0.6	0.7	0.5	0.7	1.2
2/15/2012	0.0	0.0	0.0	0.0	0.0	0.0	49.7	47.2	44.8	7.3	8.3	9.9	0.1	0.8	2.3	0.0	-0.1	-0.1	2.2	2.7	3.0	0.9	1.3	2.1
2/22/2012	0.0	0.0	0.0	0.1	0.1	0.1	43.1	41.2	39.2	17.4	18.9	19.2	2.7	3.9	5.6	-0.5	-0.5	-0.7	4.5	5.4	5.9	2.7	3.3	4.4
2/29/2012	0.1	0.1	0.1	0.1	0.2	0.2	38.4	37.1	35.5	20.2	21.3	21.0	3.6	2.7	3.5	-0.7	-0.8	-1.0	7.9	8.8	8.9	5.2	5.5	6.2
3/7/2012	0.3	0.3	0.4	0.2	0.4	0.5	37.5	36.0	34.3	27.9	28.6	28.1	4.8	4.3	5.5	-1.9	-2.0	-2.2	9.8	10.5	10.4	6.6	6.9	7.6
3/14/2012	0.6	0.5	0.6	0.5	0.6	0.7	34.7	33.1	31.5	30.1	31.3	30.1	5.0	4.5	6.1	-0.4	-0.5	-0.4	17.5	18.0	17.5	11.7	11.5	11.9
3/21/2012	1.2	1.1	1.5	0.9	1.0	1.3	39.6	38.4	36.5	19.2	19.9	19.4	-6.3	-6.8	-5.5	-0.2	-0.2	-0.2	18.8	19.4	19.0	6.9	7.0	7.1
3/28/2012	2.1	1.9	2.3	1.8	1.7	2.1	37.2	35.6	34.2	20.7	21.4	20.9	-1.1	-1.5	-0.6	-0.2	-0.2	-0.2	19.3	19.9	19.5	7.2	7.2	7.3

Table DS4. Adult Delta Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%) Inserted at Shag Slough, Water Year 2012.

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Upstream past Emmaton/Decker			Upstream past Jersey Point			Downstream past Rio Vista			Flux through Threemile Slough			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
2/1/2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-8.4	-8.1	-8.4	-0.1	-0.1	0.1	16.7	16.3	17.0	1.5	1.6	1.9	0.3	0.3	0.4
2/8/2012	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-4.8	-4.6	-4.5	0.1	0.3	0.5	15.9	15.5	16.2	2.9	3.0	3.5	1.1	1.2	1.7
2/15/2012	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	-6.6	-6.1	-6.5	-0.9	-0.7	-0.2	17.4	17.1	17.8	4.2	4.6	5.1	1.3	1.7	1.9
2/22/2012	0.1	0.2	0.4	0.3	0.4	0.6	0.1	0.1	0.1	-5.3	-4.7	-5.1	-1.0	-0.8	-0.3	16.9	16.5	17.3	5.9	6.2	6.5	1.9	1.9	2.2
2/29/2012	0.3	0.3	0.5	0.5	0.5	0.7	0.1	0.1	0.1	-5.3	-5.4	-5.7	-1.2	-1.2	-1.3	17.6	17.4	18.2	7.3	7.2	7.8	2.6	2.3	2.6
3/7/2012	0.5	0.5	0.7	0.7	0.7	0.9	0.1	0.1	0.1	-4.3	-4.6	-4.8	-1.3	-1.4	-1.3	19.1	18.8	19.3	8.0	8.0	8.3	2.8	2.5	2.6
3/14/2012	0.6	0.7	0.9	0.8	0.9	1.0	0.1	0.1	0.1	-5.7	-6.0	-6.2	-2.4	-2.2	-2.3	26.6	26.4	26.9	12.4	12.3	12.6	4.5	4.2	4.0
3/21/2012	0.9	1.0	1.2	1.1	1.1	1.3	1.7	1.6	1.7	-17.6	-17.4	-17.5	-7.2	-6.8	-6.9	32.2	31.9	32.4	14.3	14.0	14.5	2.9	2.8	2.7
3/28/2012	1.2	1.4	1.5	1.5	1.4	1.5	1.3	1.2	1.4	-16.5	-16.6	-16.7	-5.0	-4.5	-4.7	32.4	32.0	32.5	14.6	14.4	14.8	3.0	3.0	3.0

Table DS5. Adult Delta Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%) Inserted at Chipps Island, Water Year 2013.

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Upstream past Emmaton/Decker			Upstream past Jersey Point			Downstream past Rio Vista			Flux through Threemile Slough			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
12/10/2012	0.0	0.0	0.0	0.0	0.0	0.0	99.9	99.8	99.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/17/2012	0.0	0.0	0.0	0.0	0.0	0.0	93.7	92.5	91.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/24/2012	0.0	0.0	0.0	0.0	0.0	0.0	95.4	94.0	92.6	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
12/31/2012	0.0	0.0	0.0	0.0	0.0	0.0	97.9	97.0	96.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1/7/2013	0.0	0.0	0.0	0.0	0.0	0.0	97.9	96.9	96.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1/14/2013	0.0	0.0	0.0	0.0	0.0	0.0	89.4	88.6	87.3	0.1	0.1	0.1	0.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Upstream past Emmaton/Decker			Upstream past Jersey Point			Downstream past Rio Vista			Flux through Threemile Slough			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
1/21/2013	0.0	0.0	0.0	0.0	0.0	0.0	78.5	78.5	76.7	0.2	0.2	0.2	0.7	0.6	0.9	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.2
1/28/2013	0.0	0.0	0.0	0.0	0.0	0.0	64.2	64.1	63.4	2.6	2.6	2.5	2.6	2.4	2.8	0.0	0.0	0.0	0.9	0.9	0.9	1.3	1.3	1.3
2/4/2013	0.1	0.1	0.1	0.1	0.1	0.1	50.1	50.3	50.2	1.7	1.8	1.7	4.0	3.6	4.1	0.0	0.0	0.0	1.3	1.1	1.2	1.8	1.8	1.9
2/11/2013	0.2	0.3	0.3	0.2	0.3	0.3	45.1	45.5	45.4	4.4	4.0	4.1	6.7	6.8	7.1	-0.1	-0.2	-0.1	1.9	1.8	1.9	4.5	4.2	4.7
2/18/2013	0.6	0.5	0.5	0.5	0.5	0.6	41.1	41.6	41.8	3.6	3.5	3.2	4.7	4.4	5.0	-0.1	-0.2	-0.1	2.7	2.5	2.5	3.6	3.5	3.8
2/25/2013	0.9	0.8	0.8	0.8	0.7	0.9	39.9	40.4	40.7	5.0	4.9	4.5	7.4	7.6	8.0	-0.1	-0.2	-0.1	2.9	2.6	2.7	4.4	4.1	4.3
3/4/2013	1.4	1.1	1.2	1.2	1.2	1.4	38.6	39.1	39.3	6.3	5.9	6.2	9.0	8.7	9.1	-0.1	-0.2	-0.1	2.7	2.5	2.7	5.4	5.4	5.5
3/11/2013	1.7	1.4	1.6	1.5	1.5	1.8	38.2	38.6	38.8	8.5	8.7	8.8	12.2	11.6	11.9	-0.2	-0.3	-0.2	2.7	2.5	2.7	6.6	6.6	6.6

Table DS6. Adult Delta Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%) Inserted at Shag Slough, Water Year 2013.

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Upstream past Emmaton/Decker			Upstream past Jersey Point			Downstream past Rio Vista			Flux through Threemile Slough			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
12/10/2012	0.0	0.0	0.0	0.0	0.0	0.0	7.0	6.4	6.0	-22.0	-21.8	-21.7	-0.6	-0.5	-0.3	25.0	25.0	24.9	2.8	2.8	2.9	0.8	1.0	1.0
12/17/2012	0.0	0.0	0.1	0.1	0.2	0.2	6.1	5.5	4.9	-21.6	-21.5	-21.4	0.5	0.9	1.3	25.4	25.4	25.2	3.0	3.1	3.2	1.8	2.0	2.3
12/24/2012	0.2	0.3	0.4	0.4	0.6	0.7	5.9	5.4	4.5	-22.1	-22.0	-21.8	1.0	1.4	2.1	25.5	25.5	25.4	3.3	3.4	3.4	2.0	2.2	2.4
12/31/2012	0.3	0.5	0.6	0.9	1.1	1.3	10.9	10.0	9.1	-22.3	-22.2	-22.0	0.8	1.2	1.9	25.5	25.6	25.4	3.3	3.4	3.4	1.8	2.0	2.2
1/7/2013	0.6	0.9	0.9	1.3	1.5	1.7	13.9	13.4	12.3	-22.3	-22.2	-22.0	1.0	1.3	2.0	25.7	25.7	25.5	3.3	3.4	3.4	1.4	1.4	1.6
1/14/2013	0.8	1.0	1.2	1.5	1.8	1.9	12.0	11.4	10.4	-22.1	-22.1	-21.9	1.4	1.8	2.3	25.9	26.0	25.8	3.4	3.5	3.5	1.3	1.1	1.3
1/21/2013	1.0	1.2	1.4	1.7	1.9	2.1	9.4	8.8	7.9	-22.3	-22.2	-22.1	1.7	2.0	2.5	26.0	26.1	25.8	3.5	3.6	3.5	1.0	0.9	1.0
1/28/2013	1.1	1.3	1.5	1.9	2.1	2.3	7.3	7.1	6.2	-22.6	-22.3	-22.4	2.2	2.4	3.2	30.0	30.2	30.1	4.2	4.3	4.3	1.4	1.5	1.5
2/4/2013	1.3	1.4	1.7	2.0	2.3	2.4	5.9	5.7	5.1	-25.6	-25.8	-25.6	2.4	2.7	3.4	31.2	31.5	31.4	4.9	5.1	5.0	1.6	1.6	1.6
2/11/2013	1.4	1.7	1.9	2.3	2.5	2.6	5.4	5.4	4.6	-26.9	-27.1	-26.6	3.1	3.5	3.9	34.1	34.6	34.3	5.7	5.9	6.1	2.6	2.7	2.8
2/18/2013	1.7	1.9	2.1	2.5	2.7	2.9	5.1	5.0	4.3	-28.0	-28.2	-27.8	2.0	2.3	2.7	35.7	36.1	35.9	6.4	6.6	6.8	2.1	2.3	2.3
2/25/2013	1.8	2.1	2.3	2.6	2.9	3.1	5.1	5.0	4.3	-28.5	-28.8	-28.4	2.9	3.5	3.7	36.4	36.8	36.6	6.8	7.0	7.3	2.5	2.4	2.7
3/4/2013	2.1	2.3	2.6	2.9	3.1	3.4	4.9	4.8	4.1	-28.3	-28.5	-28.1	3.3	3.8	4.0	37.1	37.4	37.2	6.9	7.1	7.3	2.8	3.0	3.1
3/11/2013	2.2	2.5	2.8	3.0	3.3	3.5	4.9	4.8	4.1	-28.1	-28.4	-27.9	4.4	4.7	5.1	38.4	38.8	38.6	7.2	7.3	7.6	3.4	3.5	3.4

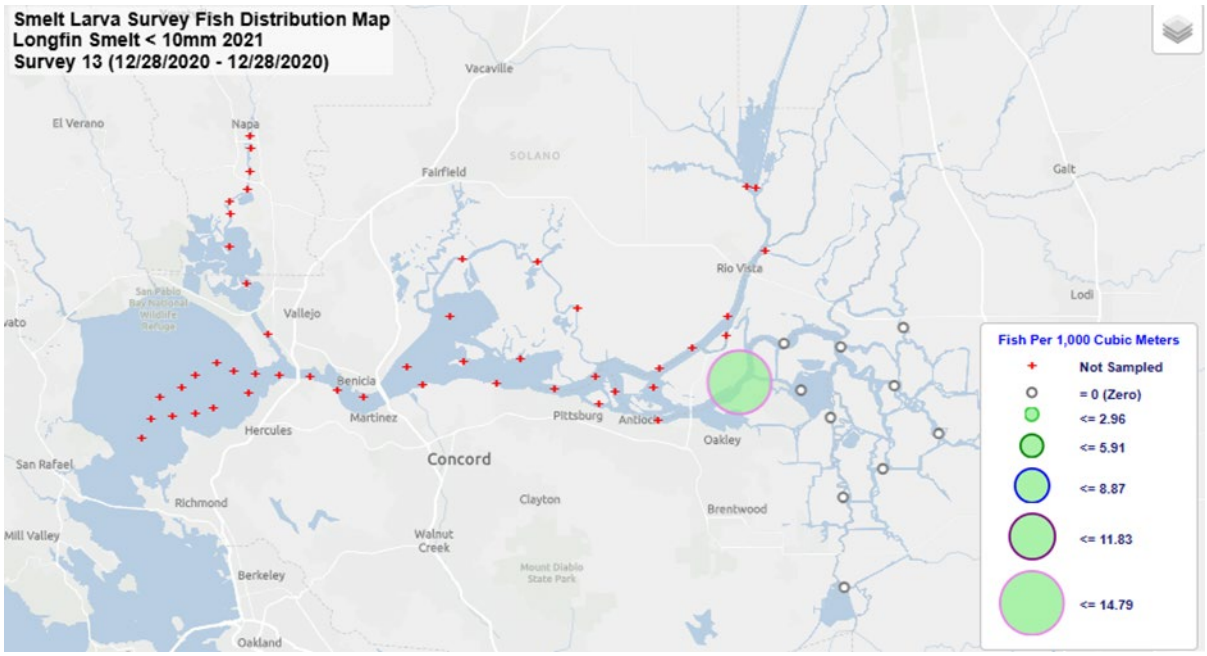
Longfin Smelt

South Delta Entrainment

The December–February time period of the First Flush Action coincides with adult and larval Longfin Smelt life stage timing (ICF 2023:4-49–4-51), indicating the potential for different south Delta entrainment risk for these life stages as a result of differences in OMR criteria that could be operated as a result of the updated decision-making approach to the First Flush Action.

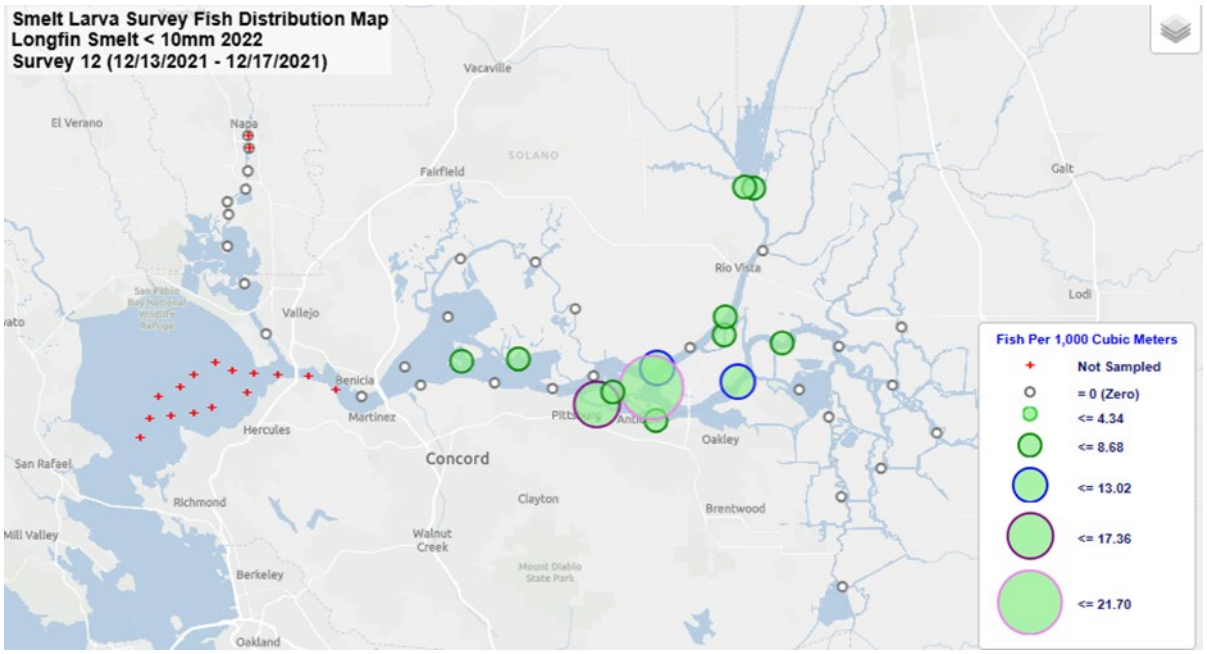
As noted in the 2024 ITP Smelt Effects Analysis, adult Longfin Smelt south Delta entrainment has been exceedingly rare since 2009 (California Department of Fish and Wildlife 2024, Attachment 5:81). The 2024 ITP COA 8.3.3 (Adult LFS Protection) would not be changed by the updated decision-making approach to the First Flush Action and would minimize entrainment risk by applying 7-day OMR requirements of either -5,000 cfs or -3,500 cfs (the latter if a -5,000-cfs requirement is already in place after the OMR management season has begun) should the salvage threshold be reached (California Department of Fish and Wildlife 2024, Attachment 5:81). Analysis of factors influencing adult Longfin Smelt salvage found that limiting average weekly OMR to be more positive than -5,000 cfs appears to dampen the magnitude of salvage compared to weekly OMR more negative than -5,000 cfs (California Department of Fish and Wildlife 2020, Appendix B), so given that different OMR values that could be adopted in the First Flush Action are not more negative than -5,000 cfs, adult entrainment risk should not be greatly different between OMR possibilities. The results of the particle tracking modeling for particles with adult Delta Smelt swimming behavior may also provide some indication of the differences in the potential for take of adult Longfin Smelt, recognizing that the modeling does not account for differences in movement behavior between adult Delta Smelt and adult Longfin Smelt, nor changes to OMR that could arise because of triggering of the criteria in other 2024 ITP COA, in particular COA 8.3.3 (Adult LFS Protection). As described above for Delta Smelt, the particle tracking modeling results for adult Delta Smelt suggested relatively limited differences between OMR scenarios in entrainment risk and other particle fates (Tables DS1–DS4).

Larval Longfin Smelt south Delta entrainment risk is minimized by 2024 ITP COA 8.4.2 (Larval and Juvenile Longfin Smelt Entrainment Protection), which from January 1 through the end of OMR management limits 7-day-average OMR to no more negative than -3,500 cfs when 7-day-average QWEST is < +1,500 cfs and Smelt Larval Survey catch exceeds thresholds reflecting Age 1+ Longfin Smelt abundance indices (California Department of Fish and Wildlife 2024, Appendix 5:83–85). This COA would be in place regardless of the updated decision-making approach to the First Flush Action and would be expected to limit differences in take or effects related to SWP south Delta exports between potential First Flush Action OMR scenarios. Although the main focus of larval Longfin Smelt entrainment risk management is from January 1 onwards, expansion of the Smelt Larva Survey to include December sampling demonstrates the possible occurrence of larvae in the central Delta prior to Jan 1 (Figures LFS1–LFS9). This presence in December indicates that differences in OMR as a result of the updated decision-making approach to the First Flush Action could result in differences in the potential for larval Longfin Smelt take and effects as a result of SWP south Delta operations.



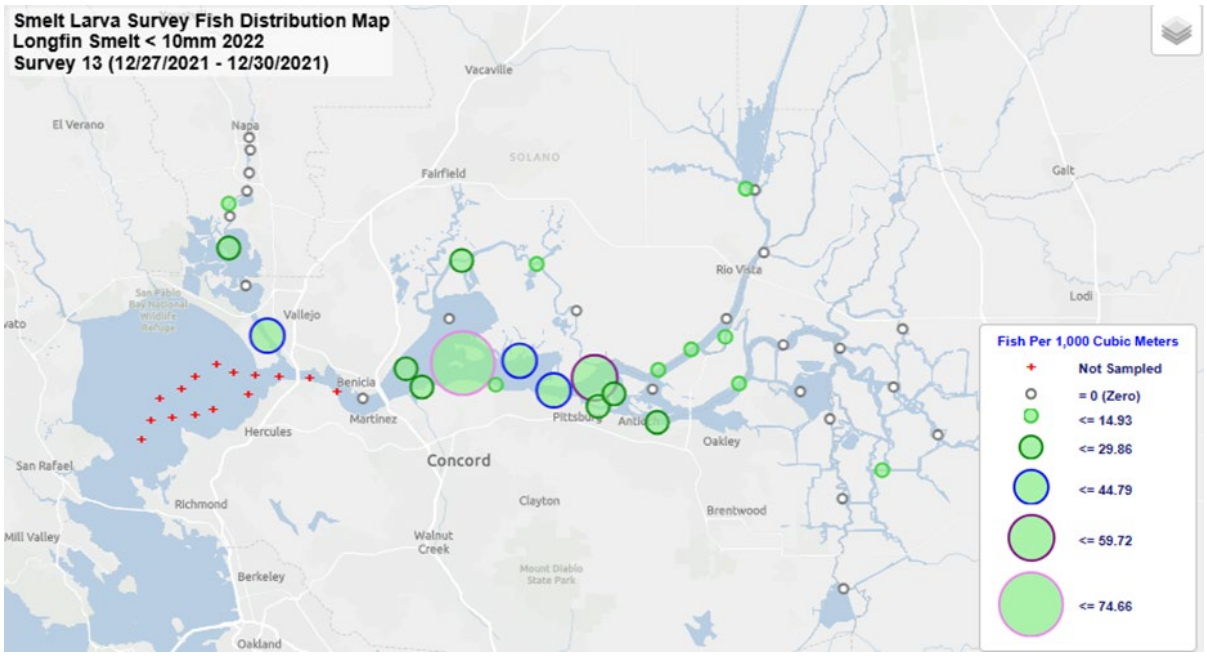
Source: California Department of Fish and Wildlife (2025).

Figure LFS1. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/28/2020.



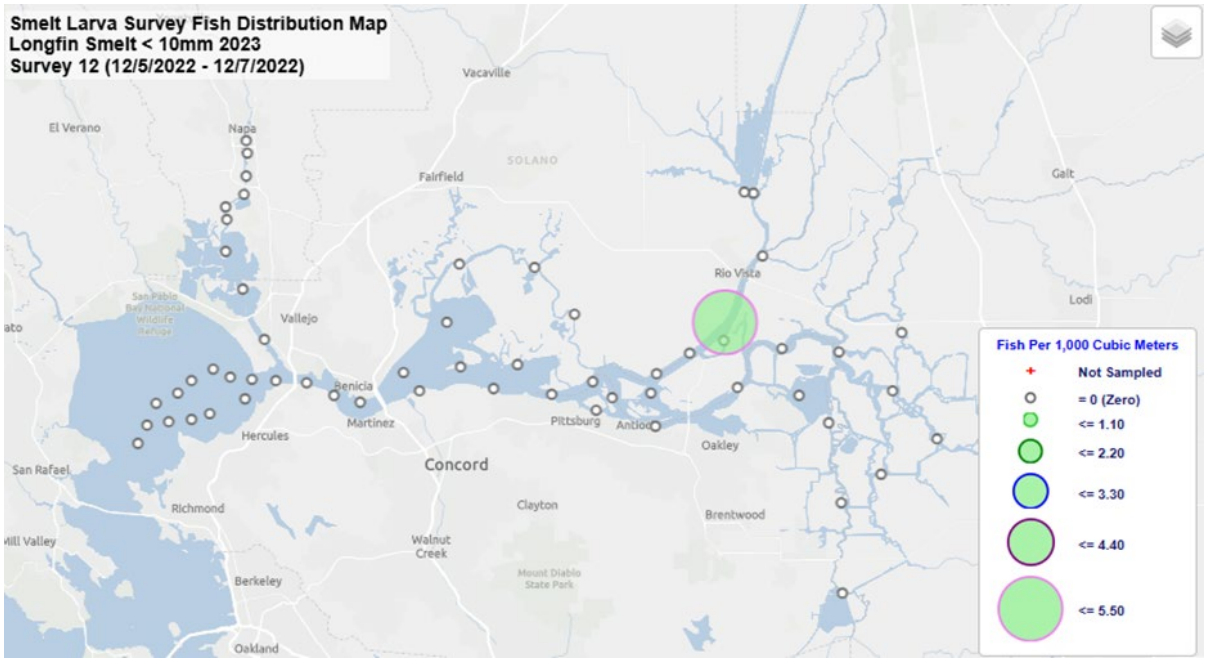
Source: California Department of Fish and Wildlife (2025).

Figure LFS2. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/13/2021–12/17/2021.



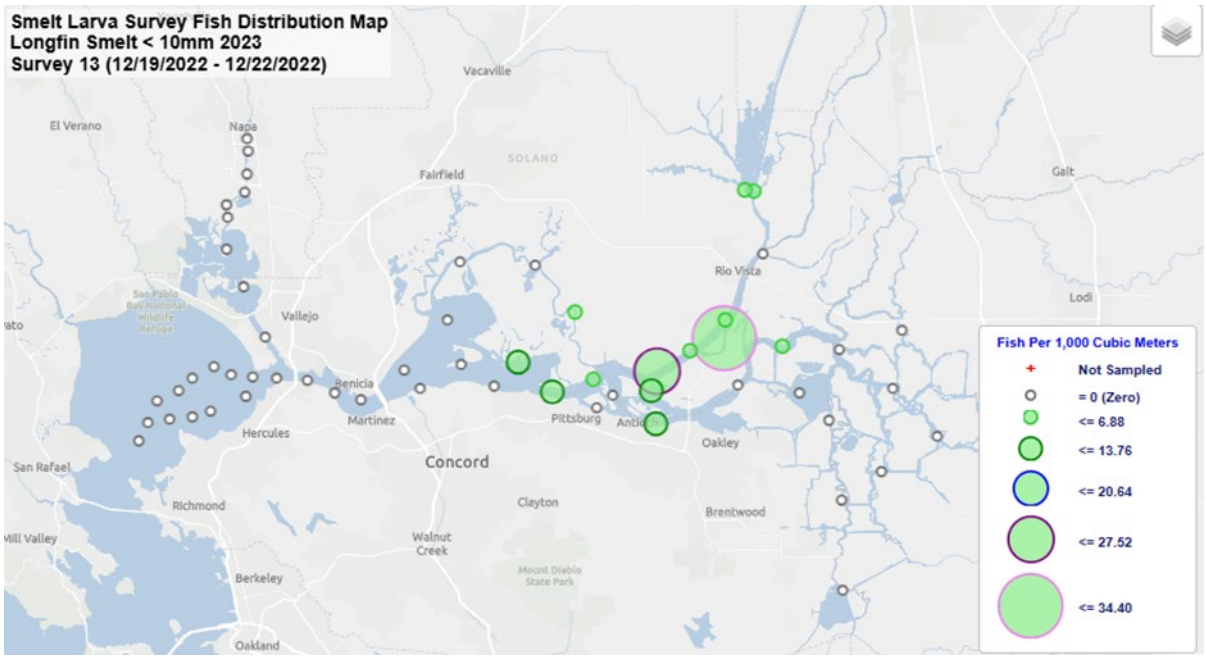
Source: California Department of Fish and Wildlife (2025).

Figure LFS3. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/27/2021–12/30/2021.



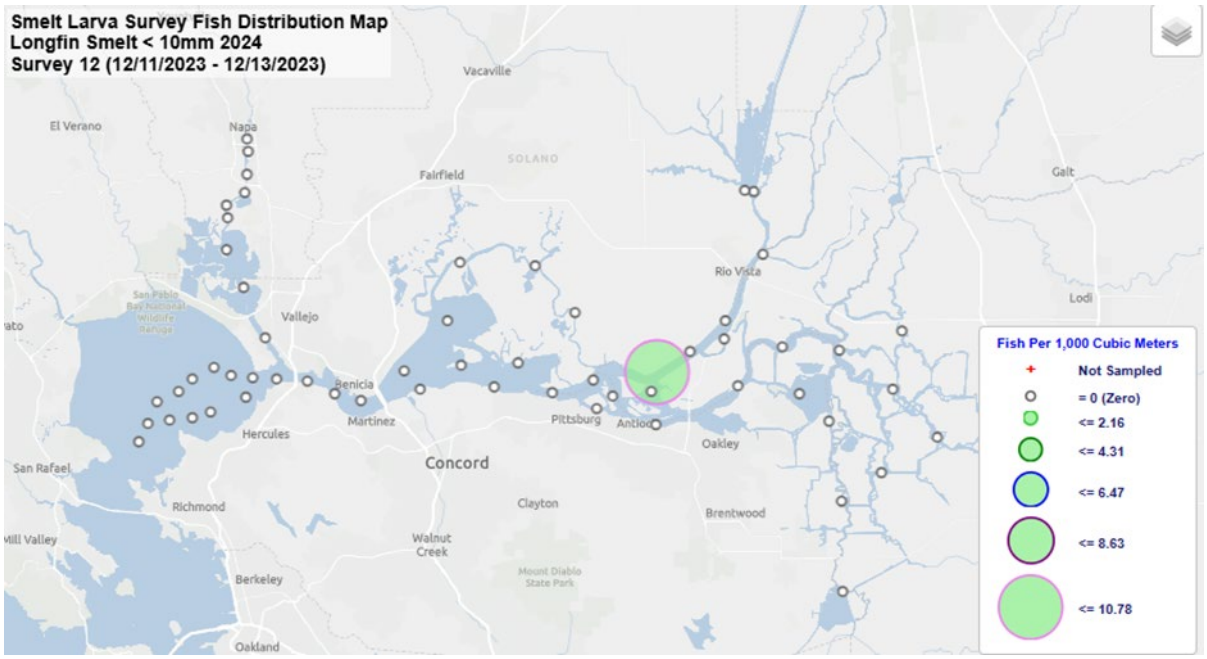
Source: California Department of Fish and Wildlife (2025).

Figure LFS4. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/5/2022–12/7/2022.



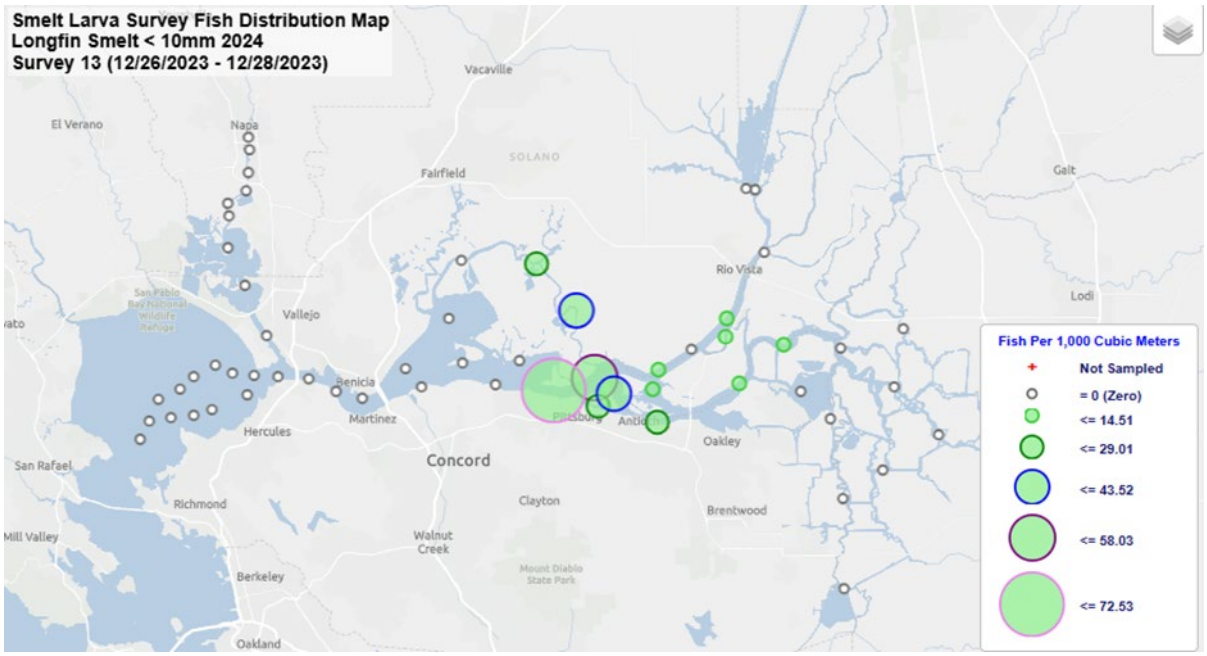
Source: California Department of Fish and Wildlife (2025).

Figure LFS5. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/19/2022–12/22/2022.



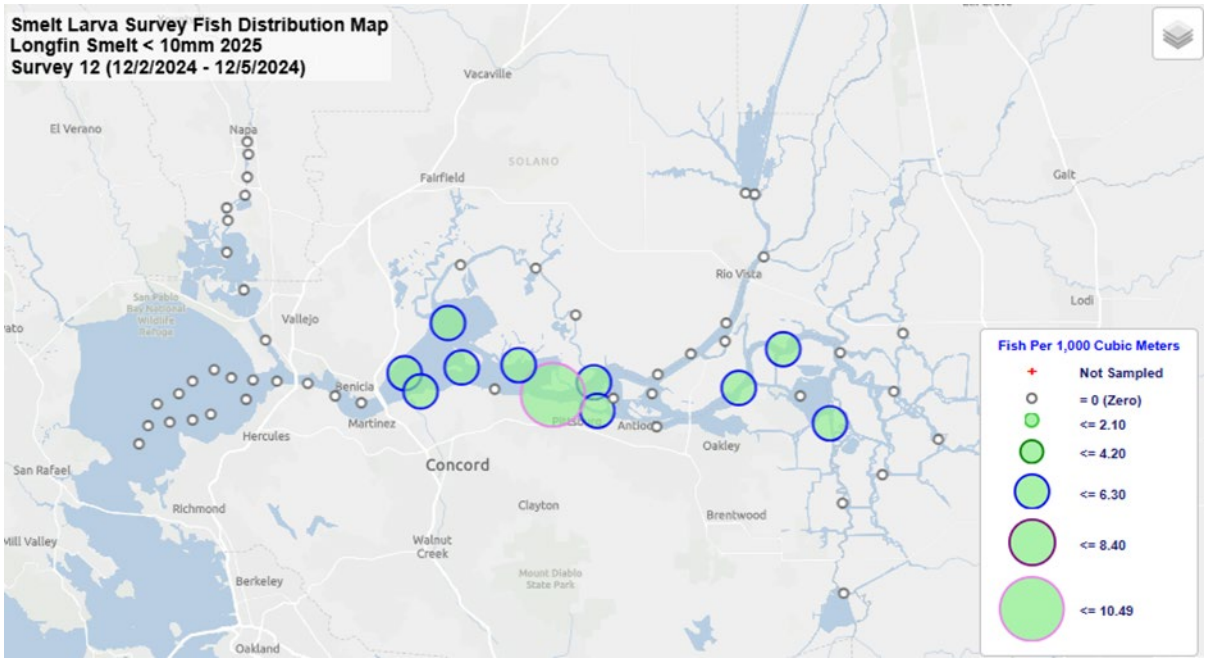
Source: California Department of Fish and Wildlife (2025).

Figure LFS6. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/11/2023–12/13/2023.



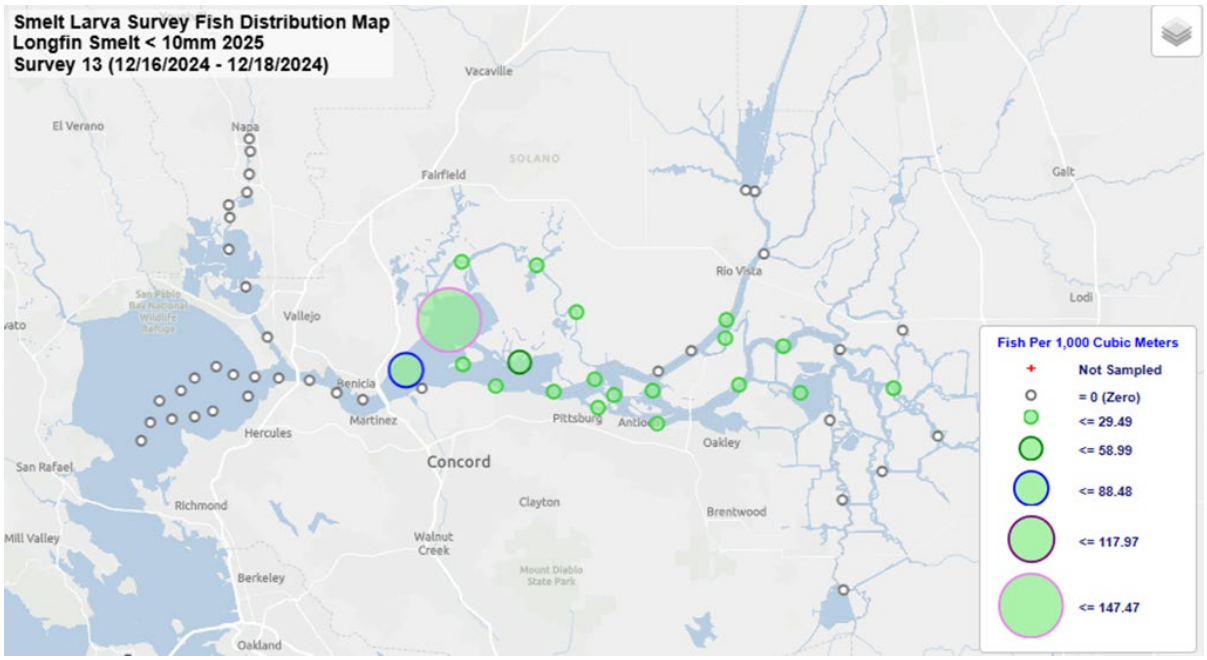
Source: California Department of Fish and Wildlife (2025).

Figure LFS7. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/26/2023–12/28/2023.



Source: California Department of Fish and Wildlife (2025).

Figure LFS8. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/2/2024–12/5/2024.



Source: California Department of Fish and Wildlife (2025).

Figure LFS9. Longfin Smelt < 10 mm Catch per Cubic Meter, Smelt Larva Survey, 12/16/2024–12/18/2024.

Particle tracking modeling for neutrally buoyant particles was undertaken to provide context for the potential for take and effects to Longfin Smelt larvae under different OMR levels that could occur with the updated decision-making approach to the First Flush Action. Particles were inserted in the lower San Joaquin River at Jersey Point, beginning the day when the First Flush Action was triggered (i.e., 12/17/2010 for WY 2011; 1/25/2012 for WY 2012; and 12/3/2012 for WY 2013). Further particle insertions then occurred daily until the end of the First Flush Action. For each insertion date, particle tracking was run for 60 days, with fates tracked weekly for percentage of particles that moved downstream past Chipps Island, were entrained at the SWP and CVP south Delta export facilities, or were unresolved in the lower San Joaquin River or the south Delta/OMR corridor (Figure LFS10).

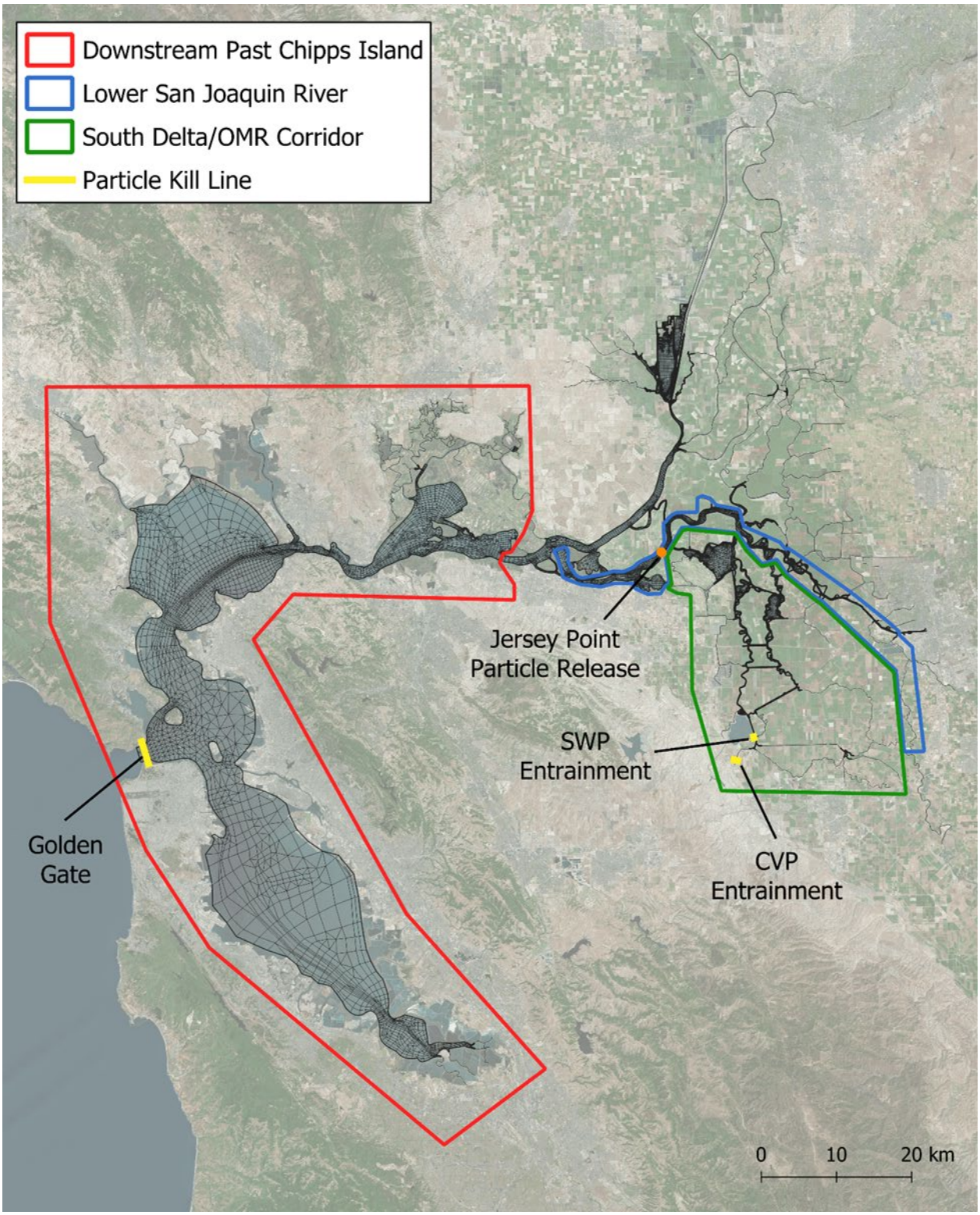


Figure LFS10. RMA Bay-Delta Model Domain with Particle Insertion Locations and Fates Tracked for the Larval Longfin Smelt Particle Tracking Modeling.

For WY 2011, the larval Longfin Smelt particle tracking analysis resulted in low percentages of particles entrained at the south Delta export facilities and few particles unresolved in the south Delta/OMR corridor, with minor differences between OMR scenarios (Table LFS1). The drier hydrology of WY 2012 and 2013 led to higher south Delta entrainment than WY 2011, but with relatively limited differences between OMR scenarios, albeit following the expected pattern of greater entrainment with more negative OMR scenarios (Tables LFS2 and LFS3). Consistent with this, the percentage of particles moving downstream past Chipps Island in WY 2012 and 2013 was lower with more negative OMR scenarios, at least during and at the end of the First Flush Action itself, with higher percentages of particles unresolved in the lower San Joaquin River and south Delta/OMR corridor. Ultimately, there was little difference between scenarios in any of the fates by the end of the full 90-day tracking period.

Table LFS1. Larval Longfin Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%), Water Year 2011

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Unresolved in Lower San Joaquin River			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
12/24/2010	0.0	0.0	0.0	0.0	0.0	0.0	68.4	66.3	64.9	17.7	18.7	19.8	0.4	0.4	0.6
12/31/2010	0.0	0.0	0.0	0.0	0.0	0.0	71.3	71.1	70.1	13.5	14.4	15.9	0.4	0.5	0.4
1/7/2011	0.0	0.0	0.0	0.0	0.0	0.0	60.8	61.7	63.1	9.0	8.6	8.8	0.2	0.2	0.2
1/14/2011	0.0	0.0	0.0	0.0	0.0	0.0	53.9	54.2	55.4	14.8	15.0	14.8	0.5	0.5	0.5
1/21/2011	0.0	0.0	0.0	0.0	0.0	0.0	44.0	44.0	44.5	13.3	13.3	13.1	0.6	0.6	0.6
1/28/2011	0.0	0.0	0.0	0.0	0.0	0.0	41.0	41.4	41.5	18.8	18.7	18.8	2.7	2.6	2.5
2/4/2011	0.2	0.2	0.2	0.0	0.0	0.0	43.7	43.9	44.0	15.1	15.2	15.3	1.5	1.4	1.4
2/11/2011	0.4	0.3	0.3	0.0	0.1	0.1	43.4	43.7	43.6	19.3	19.1	19.2	2.8	2.9	2.9
2/18/2011	0.5	0.5	0.5	0.1	0.1	0.1	42.4	42.6	42.9	16.5	16.4	16.6	2.4	2.4	2.3
2/25/2011	0.7	0.7	0.7	0.1	0.1	0.1	52.2	51.9	52.3	9.2	9.2	9.4	1.2	1.2	1.2
3/4/2011	0.8	0.8	0.8	0.1	0.1	0.1	53.4	53.4	53.7	5.5	5.5	5.5	0.3	0.3	0.3
3/11/2011	0.8	0.8	0.8	0.1	0.1	0.1	50.2	50.1	50.4	5.2	5.1	5.1	0.2	0.2	0.2
3/18/2011	0.7	0.7	0.7	0.1	0.1	0.1	39.2	39.1	39.3	3.9	3.9	3.8	0.1	0.1	0.1
3/25/2011	0.7	0.7	0.7	0.1	0.1	0.1	27.3	27.2	27.2	1.3	1.3	1.3	0.0	0.0	0.0

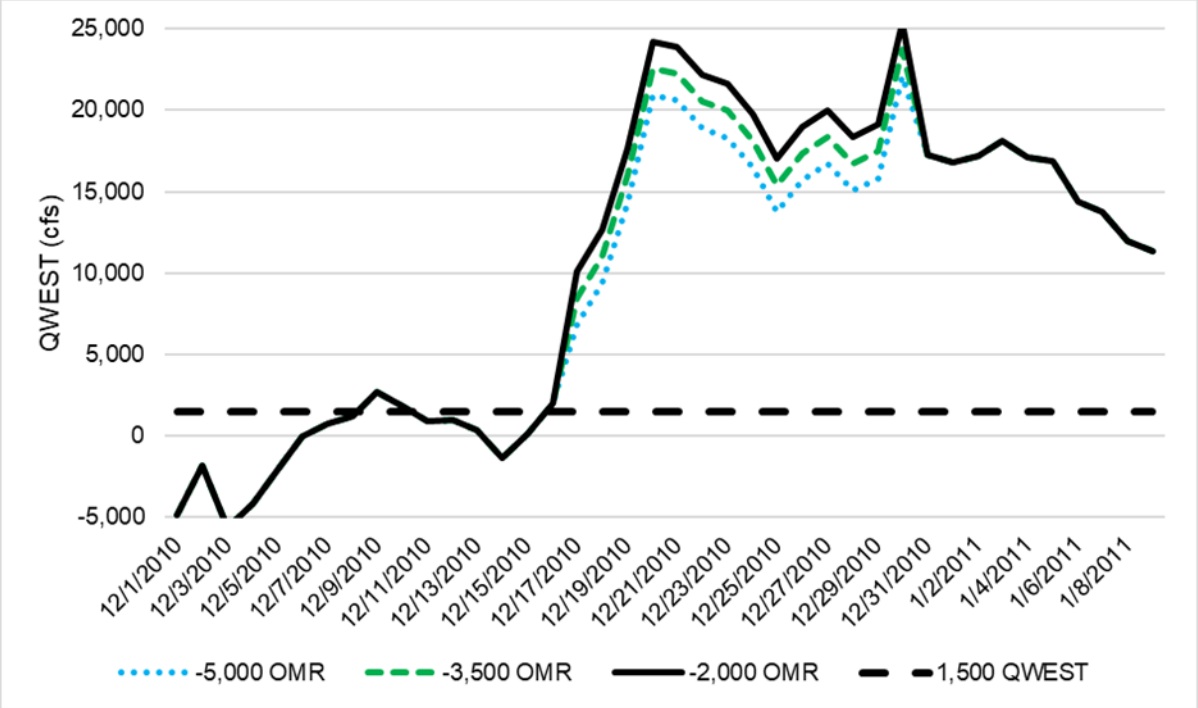
Table LFS2. Larval Longfin Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%), Water Year 2012

	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Unresolved in Lower San Joaquin River			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
2/1/2012	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.2	79.3	78.5	77.1	13.0	15.9	19.0
2/8/2012	0.0	0.1	0.3	0.0	0.1	0.2	7.4	3.8	1.9	61.8	65.6	68.2	7.7	11.4	15.2
2/15/2012	0.0	0.3	0.5	0.0	0.2	0.5	15.8	10.3	6.2	55.2	58.7	61.7	11.4	14.9	18.4
2/22/2012	0.2	0.7	1.0	0.2	0.5	0.9	31.1	25.9	20.5	41.4	43.9	46.4	7.5	9.3	11.2
2/29/2012	0.7	1.0	1.2	0.6	0.7	0.9	30.3	28.2	25.3	43.5	44.1	45.3	13.5	12.8	13.3
3/7/2012	1.4	1.6	1.9	1.3	1.3	1.6	33.1	32.7	30.9	40.0	40.0	39.9	11.2	10.5	10.7
3/14/2012	1.7	1.9	2.2	1.6	1.6	1.9	30.0	30.2	29.1	38.7	38.3	38.7	16.4	16.0	16.0
3/21/2012	2.7	2.8	3.1	2.2	2.3	2.5	47.0	47.7	47.5	27.2	26.9	26.4	8.2	7.8	7.8
3/28/2012	3.7	3.6	3.9	2.9	2.9	3.1	50.9	51.8	52.0	24.2	24.4	24.1	8.1	7.6	7.7

Table LFS3. Larval Longfin Smelt Particle Tracking Modeling: Weekly Cumulative Fate of Particles (%), Water Year 2013

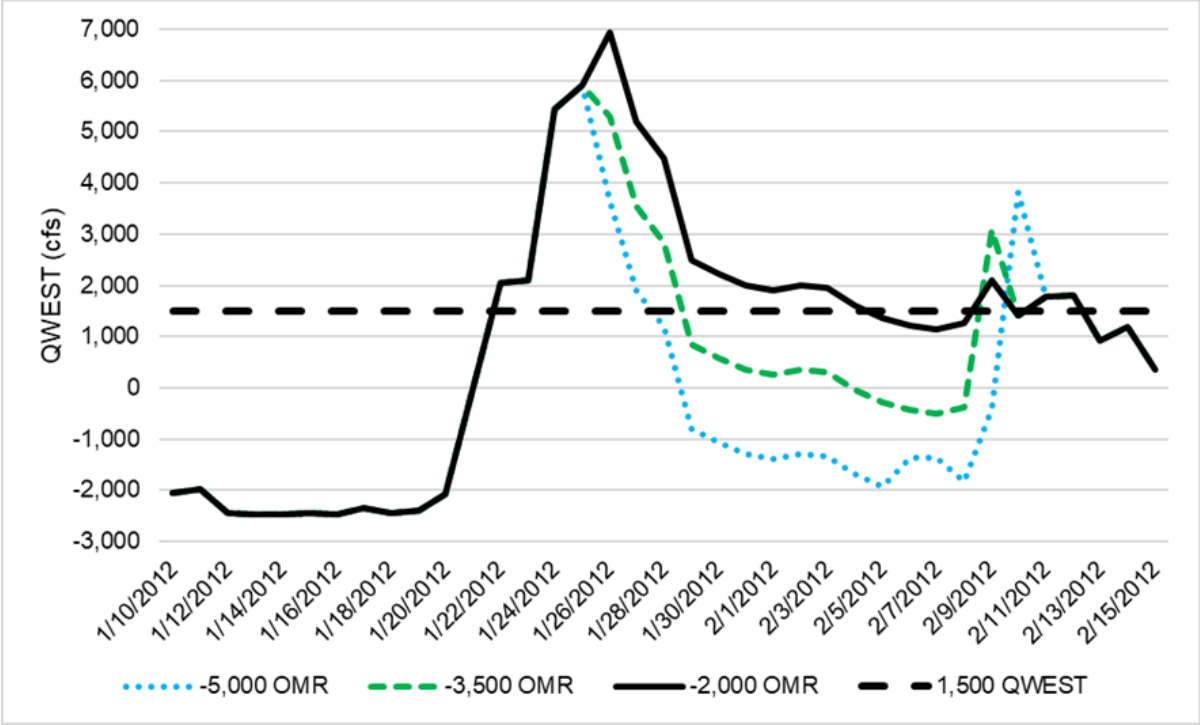
	SWP Entrainment			CVP Entrainment			Downstream past Chipps Island			Unresolved in Lower San Joaquin River			Unresolved in South Delta/OMR Corridor		
Date	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR	-2,000 cfs OMR	-3,500 cfs OMR	-5,000 cfs OMR
12/10/2012	0.0	0.0	0.0	0.0	0.0	0.0	27.0	23.6	21.2	51.5	54.8	58.0	1.8	2.2	2.9
12/17/2012	0.0	0.0	0.0	0.0	0.0	0.0	44.1	39.5	34.8	36.5	39.8	43.1	3.6	4.8	6.9
12/24/2012	0.0	0.1	0.2	0.0	0.1	0.2	47.2	42.8	37.5	36.9	39.8	42.9	5.0	6.3	8.4
12/31/2012	0.1	0.2	0.4	0.1	0.3	0.5	74.4	74.7	74.6	9.5	9.7	10.1	1.0	1.2	1.6
1/7/2013	0.2	0.3	0.5	0.2	0.3	0.6	57.2	58.5	59.6	18.1	18.1	18.2	2.6	2.7	2.9
1/14/2013	0.2	0.4	0.5	0.2	0.4	0.6	41.8	42.5	43.5	17.7	17.8	18.0	2.8	3.0	3.0
1/21/2013	0.5	0.6	0.7	0.4	0.6	0.7	36.9	37.4	38.2	23.3	23.2	23.3	7.1	7.5	7.3
1/28/2013	1.0	1.2	1.3	0.9	1.1	1.2	32.6	32.9	33.7	24.3	24.2	24.3	6.5	6.8	6.7
2/4/2013	1.8	2.1	2.1	1.6	1.8	2.0	29.7	29.7	30.5	25.9	26.1	25.7	10.6	10.5	10.7
2/11/2013	2.9	3.2	3.1	2.6	2.6	2.9	28.9	28.9	29.4	23.2	23.2	23.2	8.0	8.1	8.2
2/18/2013	3.9	4.1	4.1	3.2	3.3	3.6	27.6	27.7	28.1	23.6	23.7	24.0	11.1	11.1	10.8
2/25/2013	4.5	4.7	4.7	3.8	3.8	4.0	29.0	29.2	29.7	21.7	21.6	21.7	7.0	7.1	6.9
3/4/2013	4.8	5.0	5.0	4.0	4.1	4.3	28.1	28.4	28.7	21.8	21.8	22.0	9.2	9.4	9.1
3/11/2013	5.2	5.3	5.3	4.5	4.5	4.7	30.2	30.4	30.8	19.7	19.8	19.8	7.4	7.4	7.3

The larval Longfin Smelt particle tracking modeling results reflect differences in hydrodynamic conditions created by the OMR scenarios that would be considered with the updated decision-making approach to the First Flush Action. WY 2011 had strongly positive QWEST during the First Flush Action across all scenarios (Figure LFS10), so entrainment risk was very low. In WY 2012, the two more negative OMR scenarios resulted in QWEST considerably below +1,500 cfs (Figure LFS11), a level at which south Delta entrainment risk tends to increase (based on prior particle tracking modeling). In WY 2013, only the -5,000 cfs OMR scenario resulted in QWEST below +1,500 cfs (Figure LFS12). As previously noted above, larval Longfin Smelt south Delta entrainment risk is minimized by 2024 ITP COA 8.4.2 (Larval and Juvenile Longfin Smelt Entrainment Protection), which from January 1 through the end of OMR management limits 7-day-average OMR to no more negative than -3,500 cfs when 7-day-average QWEST is < 1,500 cfs and Smelt Larval Survey catch exceeds thresholds reflecting Age 1+ Longfin Smelt abundance indices (California Department of Fish and Wildlife 2024, Appendix 5:83–85). Thus, if hydrological conditions similar to those of WY 2012 occurred (i.e., First Flush Action occurs after January 1), COA 8.4.2 would likely be triggered if Smelt Larval Survey catch thresholds were exceeded and therefore the -5,000-cfs OMR scenario would result in an OMR more similar to the -3,500-cfs OMR scenario, which would limit entrainment risk.



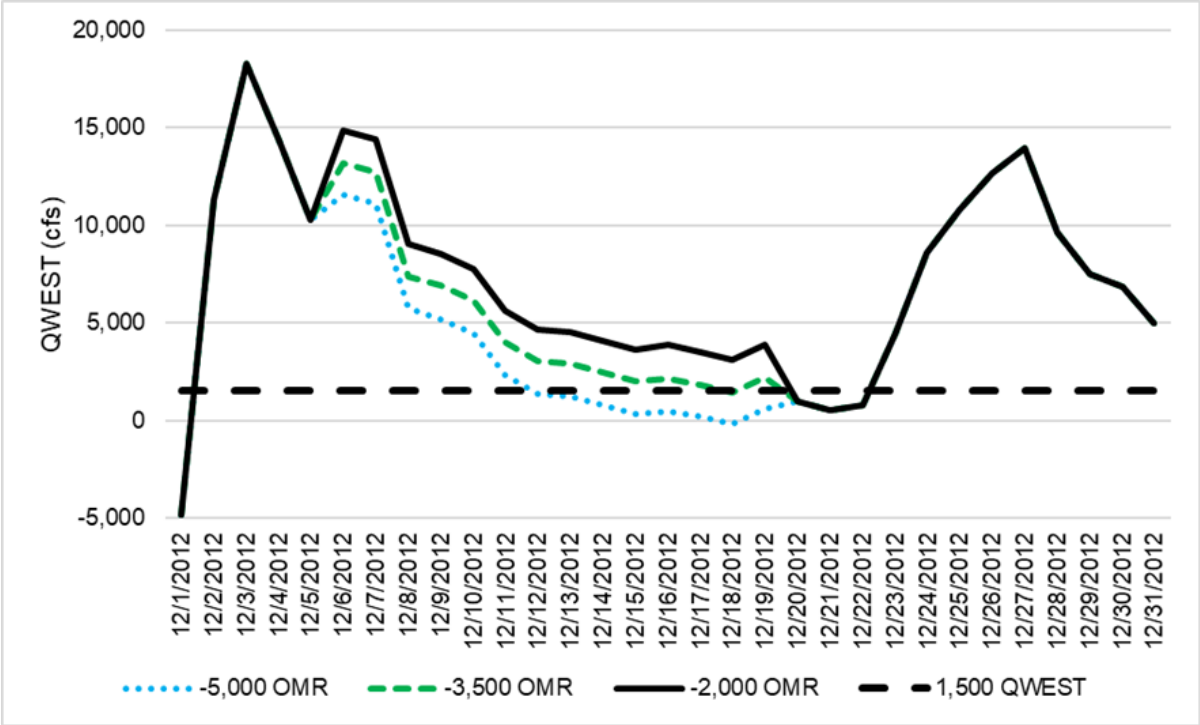
Note: Horizontal line shows QWEST = +1,500 cfs.

Figure LFS10. Mean Daily QWEST by OMR Scenario, Water Year 2011.



Note: Horizontal line shows QWEST = +1,500 cfs.

Figure LFS11. Mean Daily QWEST by OMR Scenario, Water Year 2012.



Note: Horizontal line shows QWEST = +1,500 cfs.

Figure LFS12. Mean Daily QWEST by OMR Scenario, Water Year 2013.

Delta Outflow-Abundance

In addition to the potential for take and effects related to south Delta entrainment, different OMR levels implemented under the different First Flush Action scenarios would result in different Delta outflow levels. This has the potential to affect Longfin Smelt given the species' Delta outflow-abundance index relationship. As reviewed by California Department of Fish and Wildlife (2024, Attachment 5:75–76), various Delta outflow averaging periods have been used in published scientific analyses investigating the Longfin Smelt outflow (or X2)-abundance index relationships, i.e., December–August, January–June, March–May, and December–May. The ITP Application used a Bayesian analysis including both March–May and December–May Delta outflow (ICF 2023:4-58), whereas the ITP Smelt Effects Analysis used January–June (California Department of Fish and Wildlife 2024, Attachment 5, Appendix B). Changes to OMR as a result of the updated decision-making approach to the First Flush Action (December–February) would not affect Delta outflow in months outside of this time period (e.g., March–May), but could change Delta outflow during December–February. During the three example years illustrating the potential effects of different First Flush Action OMR scenarios, December–May Delta outflow under the -2,000-cfs OMR scenario ranged from 5,377 TAF in 2012 to 21,350 TAF in 2011 (Table LFS4). Relative to the -2,000-cfs OMR scenario, the -3,500-cfs scenario reduced December–May Delta outflow by 24 to 46 TAF (0.2 to 0.6% less) and the -5,000-cfs scenario reduced December–May Delta outflow by 56 to 92 TAF (0.4 to 1.3% less; Table LFS4). January–June Delta outflow under the -2,000-cfs OMR scenario ranged from 4,517 TAF in 2013 to 21,041 TAF in 2011 (Table LFS4). Relative to the -2,000-cfs OMR scenario, the -3,500-cfs scenario reduced January–June Delta outflow by 0 to 24 TAF (0 to 0.4% less) and the -5,000-cfs scenario reduced January–June outflow by 0 to 56 TAF (0 to 1.0% less; Table LFS4). There was zero difference in 2011 and 2013 because the First Flush Action occurred in December. The ITP Smelt Effects Analysis included a Bayesian multiple regression approach which suggested a given percentage change in loge January–June Delta outflow results in a nearly equivalent percentage change in recruitment (represented by loge Fall Midwater Trawl Index) (California Department of Fish and Wildlife 2024, Attachment 5, Appendix C:9). Based on the example water years and January–June Delta outflow, this would approximate to 0% to 1% lower Fall Midwater Trawl Index. Historical Sacramento River at Freeport flow and turbidity data for nine WYs (WY 2014 to WY 2024, excluding WY 2020 and WY 2021) indicated a First Flush Action would have been triggered in six of the years, with two of these (2018 and 2019) having First Flush Action triggered after December. This, combined with the trends evident in WY 2011–2013, suggests that a reduction in January–June Delta outflow as a result of the updated decision-making approach to the First Flush Action could occur in around a third of WY in which the First Flush Action was triggered.

Table LFS4. December–May and January–June Delta Outflow under the First Flush Action OMR Scenarios By Example Water Year.

Water Year	First Flush Action OMR Scenario (cfs)	December–May Delta Outflow (TAF)	January–June Delta Outflow (TAF)
2011	-2,000	21,350	21,041
2011	-3,500	21,304	21,041
2011	-5,000	21,258	21,041
2012	-2,000	5,377	5,517
2012	-3,500	5,352	5,493
2012	-5,000	5,321	5,461
2013	-2,000	7,217	4,517

Water Year	First Flush Action OMR Scenario (cfs)	December–May Delta Outflow (TAF)	January–June Delta Outflow (TAF)
2013	-3,500	7,171	4,517
2013	-5,000	7,125	4,517

Winter-Run and Spring-Run Chinook Salmon

South Delta Entrainment

The loss density (i.e., number of fish lost to entrainment per 1,000 acre-feet of water exported at the Banks Pumping Plant) of genetically identified and coded-wire-tagged winter-run and spring-run Chinook Salmon provides context for the potential for temporal overlap with the First Flush Action (Tables CS1–CS4). These data show that there is overlap between the First Flush Action (December–February) and historical winter-run and spring-run Chinook Salmon SWP entrainment loss, although the highest loss density occurs after February.

Table CS1. Mean Monthly Loss Density (Number of Fish Lost to Entrainment Per 1,000 Acre-Feet of Water Exported at the Banks Pumping Plant) of Genetically Identified Winter-Run Chinook Salmon by Water Year Type, Water Years 2010–2024

Month	Wet	Above Normal	Below Normal	Dry	Critically Dry
January	0.020	0.046	0.054	0.000	0.000
February	0.447	0.078	0.739	0.000	0.000
March	1.210	0.605	2.308	0.719	0.039
April	0.196	0.000	0.076	0.152	0.143
May	0.004	0.000	0.000	0.000	0.000
June	0.000	0.000	0.000	0.000	0.000
July	0.000	0.000	0.000	0.000	0.000
August	0.000	0.000	0.000	0.000	0.000
September	0.000	0.000	0.000	0.000	0.000
October	0.000	0.000	0.000	0.000	0.000
November	0.000	0.000	0.000	0.000	0.000
December	0.012	0.000	0.000	0.000	0.000

Source: Reece pers. comm. (loss data); https://apps.wildlife.ca.gov/Salvage (export data).

Table CS2. Mean Monthly Loss Density (Number of Fish Lost to Entrainment Per 1,000 Acre-Feet of Water Exported at the Banks Pumping Plant) of Coded-Wire-Tagged Winter-Run Chinook Salmon by Water Year Type, Water Years 2010–2024

Month	Wet	Above Normal	Below Normal	Dry	Critically Dry
January	0.000	0.000	0.000	0.000	0.000
February	0.000	0.000	0.000	0.000	0.013
March	0.000	0.025	0.099	0.029	0.000
April	0.000	0.000	0.036	0.000	0.000
May	0.000	0.000	0.000	0.000	0.000
June	0.000	0.000	0.000	0.000	0.000
July	0.000	0.000	0.000	0.000	0.000

Month	Wet	Above Normal	Below Normal	Dry	Critically Dry
August	0.000	0.000	0.000	0.000	0.000
September	0.000	0.000	0.000	0.000	0.000
October	0.000	0.000	0.000	0.000	0.000
November	0.000	0.000	0.000	0.000	0.000
December	0.000	0.000	0.000	0.000	0.000

Source: Costa pers. comm. and Reece pers. comm. (loss data); https://apps.wildlife.ca.gov/Salvage (export data).

Table CS3. Mean Monthly Loss Density (Number of Fish Lost to Entrainment Per 1,000 Acre-Feet of Water Exported at the Banks Pumping Plant) of Genetically Identified Spring-Run Chinook Salmon by Water Year Type, Water Years 2017–2024

Month	Wet	Above Normal	Below Normal	Dry	Critically Dry
January	0.005	0.157	0.000	0.000	0.000
February	0.010	1.203	0.000	0.000	0.000
March	0.017	4.326	0.124	0.000	0.000
April	0.082	2.068	0.635	0.488	0.142
May	0.216	0.000	0.000	0.000	0.101
June	0.000	0.054	0.000	0.000	0.000
July	0.000	0.000	0.000	0.000	0.000
August	0.000	0.000	0.000	0.000	0.000
September	0.000	0.000	0.000	0.000	0.000
October	0.000	0.000	0.000	0.000	0.000
November	0.000	0.000	0.000	0.000	0.000
December	0.058	0.000	0.000	0.000	0.000

Source: Reece pers. comm. (loss data); https://apps.wildlife.ca.gov/Salvage (export data). Note: Methods for genetic identification of spring-run Chinook Salmon continue to be refined; preliminary analysis for water year 2024 with refined genetic methods suggests that just over 25% of juvenile Chinook salmon lost to entrainment that were identified as spring-run Chinook salmon with prior genetic methods would have been identified as spring-run based on the refined genetic methods (Nguyen pers. comm.). The loss-density data summarized herein used the prior methods because only one year (2024) had data available for the refined methods.

Table CS4. Mean Monthly Loss Density (Number of Fish Lost to Entrainment Per 1,000 Acre-Feet of Water Exported at the Banks Pumping Plant) of Coded-Wire-Tagged Spring-Run Chinook Salmon by Water Year Type, Water Years 2010–2024

Month	Wet	Above Normal	Below Normal	Dry	Critically Dry
January	0.000	0.000	0.000	0.000	0.000
February	0.000	0.000	0.000	0.000	0.000
March	0.000	0.000	0.000	0.000	0.000
April	0.000	0.040	0.014	0.016	0.000
May	0.000	0.000	0.000	0.000	0.000
June	0.000	0.000	0.000	0.000	0.000
July	0.000	0.000	0.000	0.000	0.000
August	0.000	0.000	0.000	0.000	0.000
September	0.000	0.000	0.000	0.000	0.000
October	0.000	0.000	0.000	0.000	0.000

Month	Wet	Above Normal	Below Normal	Dry	Critically Dry
November	0.000	0.000	0.000	0.000	0.000
December	0.000	0.000	0.000	0.000	0.000

Source: Costa pers. comm. and Reece pers. comm. (loss data); https://apps.wildlife.ca.gov/Salvage (export data).

Tillotson et al. (2022) used a quantile regression forest approach to forecast winter-run Chinook Salmon entrainment loss risk, based on historical length-at-date-identified winter-run Chinook Salmon data. They found that, holding other variables at mean levels, predicted loss increased steeply between OMR just below 0 cfs and ∼-2,000 cfs, with little change in predicted loss to ∼ -3,500 cfs, followed by another relatively steep increase approaching -5,000 cfs (see Tillotson et al. 2022, Figure 4A). This suggests that there is the potential for greater take by entrainment loss of winter-run Chinook Salmon if occurring during the First Flush Action for OMR of -5,000 cfs, but less potential for difference between -2,000-cfs and -3,500-cfs OMR scenarios. Regardless of the proposed updated decision-making approach to the First Flush Action, DWR would continue to implement 2024 ITP COAs 8.2.1 (Natural-Origin Winter-Run Chinook Salmon Early Season Weekly Loss Thresholds), 8.4.3 (Winter-Run Chinook Salmon Annual Loss Thresholds), and 8.4.4 (Natural-Origin Winter-Run Chinook Salmon Weekly Distributed Loss Thresholds) to minimize take and effects on winter-run Chinook Salmon, with additional minimization evaluated through the Adaptive Management Program (California Department of Fish and Wildlife 2024, Attachment 6:208–241).

For spring-run Chinook Salmon, there is likely greater potential for take and effects from the First Flush Action on yearlings than young-of-the-year, as reflected in the typical timing of release of surrogates that are used in entrainment risk management (California Department of Fish and Wildlife 2024, Attachment 6: Figure 71). Although there is the potential for greater take and effects as a result of the updated decision-making approach to the First Flush Action, 2024 ITP COA 8.4.5 (Spring-Run Chinook Salmon Protection and Surrogate Annual Loss Thresholds) would continue to apply between November 1 and the end of OMR Management, thereby minimizing take and effects (California Department of Fish and Wildlife 2024, Attachment 6:242–249) by adjusting OMR to no more negative than -3,500 cfs during the OMR Management period.

Through-Delta Survival

The different OMR scenarios that could be implemented under the updated decision-making approach to the First Flush Action would not affect Delta inflow but would affect interior Delta flows at a level that would increase closer to the south Delta export facilities (particularly moving south down the Old and Middle River corridors). Therefore, based on the timing of First Flush Action, through-Delta survival of young-of-the-year winter-run and yearling Sacramento River basin spring-run Chinook Salmon entering the interior Delta via Georgiana Slough or the Delta Cross Channel (if open) could be different between the different OMR scenarios contemplated under the updated decision-making approach to the First Flush Action. These potential differences were assessed using ECO-PTM for salmon particles (Wang et al. 2024). Particles were inserted daily in the Sacramento River at Freeport (100 particles every 15 minutes) during November 15, 2011, through March 31, 2012 for WY 2012; and November 1, 2012, through March 31, 2013, for WY 2013. The simulation for each insertion was run for 90 days. It was assumed that the Georgiana Slough Salmonid Migratory Barrier BioAcoustic Fish Fence (BAFF) reduced flow-predicted entry into Georgiana Slough by 65 percent, reflecting preliminary winter-run Chinook Salmon results from the WY 2024 field deployment of the BAFF per the 2024 SWP ITP COA 8.11.1 (Install and Operate the Georgiana Slough Salmonid Migratory Barrier).

The results of the ECO-PTM for salmon particles indicated very limited differences in through-Delta survival between scenarios (Figures CS1 and CS2). During the WY 2012 First Flush Action, the mean difference between scenarios was no more than around 0.01 in absolute terms, with a mean relative difference of 1.3% lower survival under the -3,500-cfs OMR scenario compared to the -2,000-cfs OMR scenario, and a mean relative difference of 2.7% lower survival under the -5,000-cfs OMR scenario compared to the -2,000-cfs OMR scenario. During the WY 2013 First Flush Action, the mean difference between scenarios was again no more than around 0.01 in absolute terms, with a mean relative difference of 0.5% lower survival under the -3,500-cfs OMR scenario compared to the -2,000-cfs OMR scenario, and a mean difference of 0.9% lower survival under the -5,000-cfs OMR scenario compared to the -2,000-cfs OMR scenario.

Figure CS1. Through-Delta Survival Probability from ECO-PTM for Salmon Particles, Water Year 2012.

Figure CS2. Through-Delta Survival Probability from ECO-PTM for Salmon Particles, Water Year 2013.

Reintroduced juvenile Spring-run Chinook Salmon emigrate from the San Joaquin River basin through the Delta, with juveniles emigrating between February and June per the SWP ITP salmon effects analysis (California Department of Fish and Wildlife 2024, Attachment 6:55). The early (February) portion of this emigration therefore could overlap with the First Flush Action. Potential effects were assessed with the San Joaquin River Juvenile Chinook Salmon Through-Delta Survival (Structured Decision Model Routing Application; ICF 2023, Appendix D:D-463) applied to WY 2012, which was the only year of the three example WY with a First Flush Action overlapping February (i.e., two weeks beginning 1/25/2012). This showed higher survival under the -5,000-cfs and -3,500-cfs OMR scenarios than the -2,000-cfs OMR scenario during the First Flush Action (Figure CS3), the result of higher exports under the -5,000-cfs and -3,500-cfs scenarios leading to greater probability of entering SWP or CVP salvage, with greater probability of surviving salvage (through SWP or CVP) than remaining in Old River and surviving to Chipps Island (see model parameters in ICF 2023, Appendix D: Table D-17). Note that following the First Flush Action in mid-late February, the hydrological modeling included a period of higher exports under the -2,000-cfs OMR scenario than the other scenarios, reflecting operations being less constrained to meet Delta X2 criteria under that scenario because of the earlier restriction during the First Flush Action, leading to higher survival under the -2,000-cfs OMR scenario during that time (Figure CS3). Overall, the results from the San Joaquin River Juvenile Chinook Salmon Through-Delta Survival (Structured Decision Model Routing Application) were consistent with the conclusions of Buchanan and Whitlock (2022:1128): "Although we expected lower survival out of the Delta when exports were higher, the 2010–2017 acoustic telemetry data provided no evidence of that. Instead, the data were more consistent with a positive association between CVP exports and survival, especially in the OR [Old River] route during wet years…, although these findings were accompanied by considerable uncertainty and depended on a single study year (2011)."

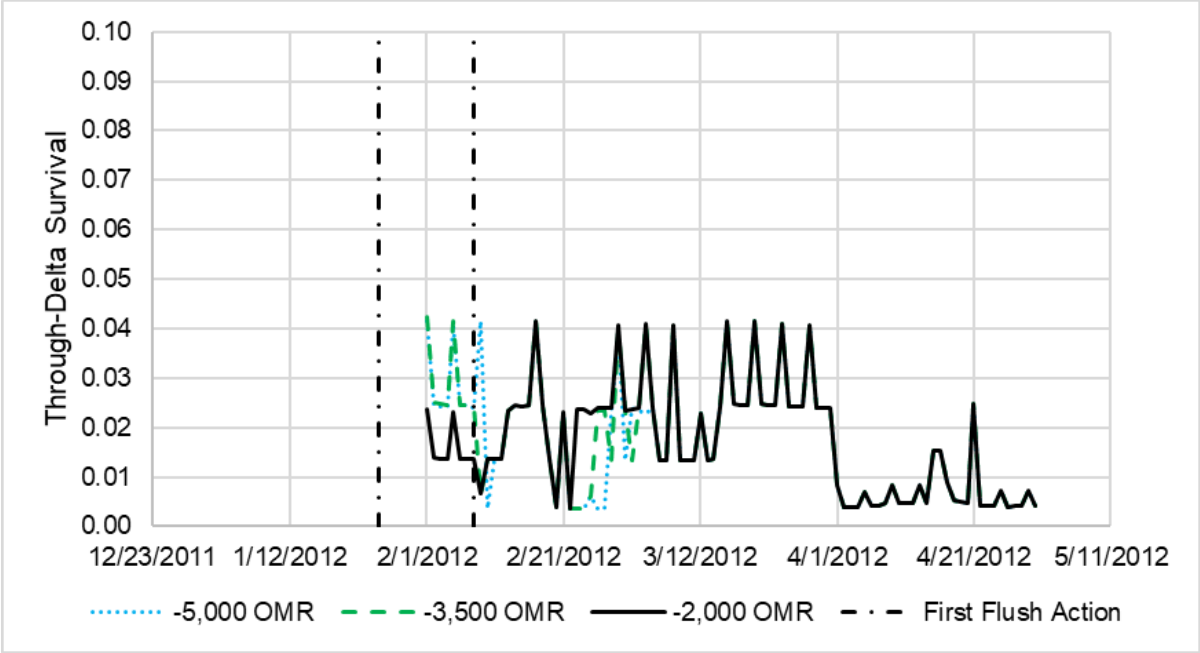


Figure CS3. Through-Delta Survival Probability from San Joaquin River Juvenile Chinook Salmon Through-Delta Survival (Structured Decision Model Routing Application, Water Year 2012.

White Sturgeon

Historical salvage-density data indicate temporal overlap of White Sturgeon salvage with the December–February First Flush Action period (Table WS1). During WY 2010–2024, White Sturgeon salvage in December–February made up sizeable portions of total annual salvage, with a maximum >80% in 2024 (Table WS2). This indicates greater potential for salvage with higher SWP exports under First Flush Action OMR scenarios with more negative OMR flows, as shown by statistical modeling undertaken for the 2024 SWP ITP (California Department of Fish and Wildlife 2024, Attachment 7:69–93). The December–February First Flush Action period could overlap with early larval occurrence in February, although most larvae would be expected to occur after February: California Department of Fish and Wildlife's Larval Entrainment Survey sampling during January–March/May, 2022–2024, collected two larval White Sturgeon in March 2024 in the lower San Joaquin River (Gilbert et al. 2025). If a First Flush Action occurred during February, there could be some risk of greater south Delta entrainment of larval White Sturgeon, although most larval entrainment risk would occur after February based on historical periods of larval occurrence in the Larval Entrainment Survey and the Smelt Larva Survey (Table WS3). However, regardless of the updated decision-making approach to the First Flush Action, 2024 SWP ITP COA 8.4.7 (White Sturgeon Entrainment Protection Action) and any eventual refinement to it through COA 8.4.8 (Evaluate and Develop Alternative White Sturgeon Entrainment Minimization During Real-Time OMR Management) would remain in place year-round to minimize entrainment and subsequent take of White Sturgeon through the development of a risk assessment and coordinated actions (California Department of Fish and Wildlife 2024, Attachment 7:127–129).

Table WS1. Mean Monthly Salvage Density (Number of Fish Salvaged Per 1,000 Acre-Feet of Water Exported at the Banks Pumping Plant) of White Sturgeon by Water Year Type, Water Years 2010–2024

Month	Wet	Above Normal	Below Normal	Dry	Critically Dry
January	0.014	0.081	0.000	0.019	0.000
February	0.002	0.192	0.000	0.000	0.000
March	0.006	0.000	0.007	0.000	0.000
April	0.000	0.000	0.004	0.000	0.000
May	0.007	0.000	0.000	0.050	0.000
June	0.008	0.081	0.037	0.000	0.000
July	0.007	0.000	0.000	0.000	0.000
August	0.005	0.000	0.000	0.000	0.000
September	0.002	0.000	0.000	0.000	0.000
October	0.000	0.000	0.000	0.000	0.000
November	0.000	0.023	0.008	0.000	0.000
December	0.001	0.085	0.012	0.000	0.000

Source: https://apps.wildlife.ca.gov/Salvage.

Table WS2. White Sturgeon Total SWP Salvage and December–February Salvage as Percentage of Total Salvage, Water Years 2010–2024

Water Year	Total SWP Salvage	December–February Salvage as % of Total
2010 (BN)	8	0%
2011 (W)	10	0%
2012 (BN)	12	0%
2013 (D)	12	50%
2014 (C)	0	—
2015 (C)	0	—
2016 (BN)	0	—
2017 (W)	35	26%
2018 (BN)	23	78%
2019 (W)	12	67%
2020 (D)	0	—
2021 (C)	0	—
2022 (C)	0	—
2023 (W)	2	0%
2024 (AN)	89	82%

Source: https://apps.wildlife.ca.gov/Salvage.

Table WS3. Summary of Smelt Larva Survey Sampling and Associated Monthly Catch of White Sturgeon Larvae, Water Years 2009–2024.

	December						January						February						March				
Water Year (Type)	Number of Samples	First Sample Date	Last Sample Date	Catch	First Catch Date	Last Catch Date	Number of Samples	First Sample Date	Last Sample Date	Catch	First Catch Date	Last Catch Date	Number of Samples	First Sample Date	Last Sample Date	Catch	First Catch Date	Last Catch Date	Number of Samples	First Sample Date	Last Sample Date	Catch	First Catch Date	Last Catch Date
2009 (D)	—	—	—	—	—	—	68	2009-01-05	2009-01-23	0	—	—	70	2009-02-02	2009-02-18	0	—	—	35	2009-03-02	2009-03-03	0		
2010 (BN)	—	—	—	—	—	—	68	2010-01-04	2010-01-21	0	—	—	69	2010-02-01	2010-02-17	0	—	—	70	2010-03-01	2010-03-24	0		
2011 (W)	—	—	—	—	—	—	56	2011-01-18	2011-01-31	0	—	—	69	2011-02-01	2011-02-28	0	—	—	50	2011-03-02	2011-03-23	0		
2012 (BN)	—	—	—	—	—	—	70	2012-01-09	2012-01-24	0	—	—	70	2012-02-06	2012-02-22	0	—	—	60	2012-03-05	2012-03-20	0		
2013 (D)	—	—	—	—	—	—	105	2013-01-02	2013-01-29	0	—	—	70	2013-02-11	2013-02-26	0	—	—	35	2013-03-18	2013-03-19	0		
2014 (C)	—	—	—	—	—	—	88	2014-01-06	2014-01-23	0	—	—	88	2014-02-03	2014-02-20	0	—	—	88	2014-03-03	2014-03-21	0		
2015 (C)	—	—	—	—	—	—	76	2015-01-05	2015-01-26	0	—	—	88	2015-02-02	2015-02-19	0	—	—	79	2015-03-02	2015-03-26	0		
2016 (BN)	—	—	—	—	—	—	88	2016-01-04	2016-01-21	0	—	—	100	2016-02-01	2016-02-29	0	—	—	67	2016-03-01	2016-03-17	0		
2017 (W)	—	—	—	—	—	—	109	2017-01-03	2017-01-31	0	—	—	99	2017-02-01	2017-02-28	2	2017-02-28	2017-02-28	53	2017-03-02	2017-03-16	0		
2018 (BN)	—	—	—	—	—	—	123	2018-01-02	2018-01-31	0	—	—	88	2018-02-01	2018-02-28	0	—	—	53	2018-03-05	2018-03-22	0		
2019 (W)	—	—	—	—	—	—	104	2019-01-02	2019-01-30	0	—	—	69	2019-02-11	2019-02-27	0	—	—	35	2019-03-11	2019-03-14	6	2019-03-12	2019-03-14
2020 (D)				0	—	—	67	2020-01-06	2020-01-22	0	—	—	70	2020-02-03	2020-02-20	0	—	—	70	2020-03-02	2020-03-18	0		
2021 (C)	24	2020-12-14	2020-12-28	0	—	—	58	2021-01-11	2021-01-26	0	—	—	70	2021-02-08	2021-02-25	0	—	—	70	2021-03-08	2021-03-17	0		
2022 (C)	88	2021-12-13	2021-12-30	0	—	—	56	2022-01-18	2022-01-28	0	—	—	87	2022-02-08	2022-02-28	0	—	—	88	2022-03-07	2022-03-24	0		
2023 (W)	118	2022-12-05	2022-12-22	0	—	—	154	2023-01-03	2023-01-31	0	—	—	108	2023-02-01	2023-02-28	0	—	—	81	2023-03-01	2023-03-17	0		
2024 (AN)	118	2023-12-11	2023-12-28	—	—	—	118	2024-01-08	2024-01-25	0	—	—	118	2024-02-05	2024-02-22	0	—	—	116	2024-03-04	2024-03-22	2	2024-03-05	2024-03-05

Source: https://filelib.wildlife.ca.gov/Public/Delta%20Smelt/ Note: Water Year types are Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C).

The different OMR scenarios that could occur under the updated decision-making approach to the First Flush Action would result in differences in Delta outflow during December–February. As described in the 2024 ITPA supplement for White Sturgeon, previous studies have shown positive relationships between White Sturgeon year class strength and Delta outflow (ICF 2024:4-5). Based on prior literature, the 2024 ITPA supplement for White Sturgeon examined potential effects based on regressions with March–July and April–May Delta outflow, both of which periods are after the December–February period during which outflow could differ under the updated decision-making approach to the First Flush Action. The statistical analysis included in CDFW's 2024 ITP White Sturgeon effects analysis suggested little effect of winter (December–February) Delta outflow on the probability of capturing a White Sturgeon in a month during surveys (California Department of Fish and Wildlife 2024, Attachment 7:63 [Figure 19]). These pieces of evidence suggest that there would be expected to be little, if any, effect of differences in Delta outflow during December–February as a result of the OMR scenarios that could occur with the updated decision-making approach to the First Flush Action.

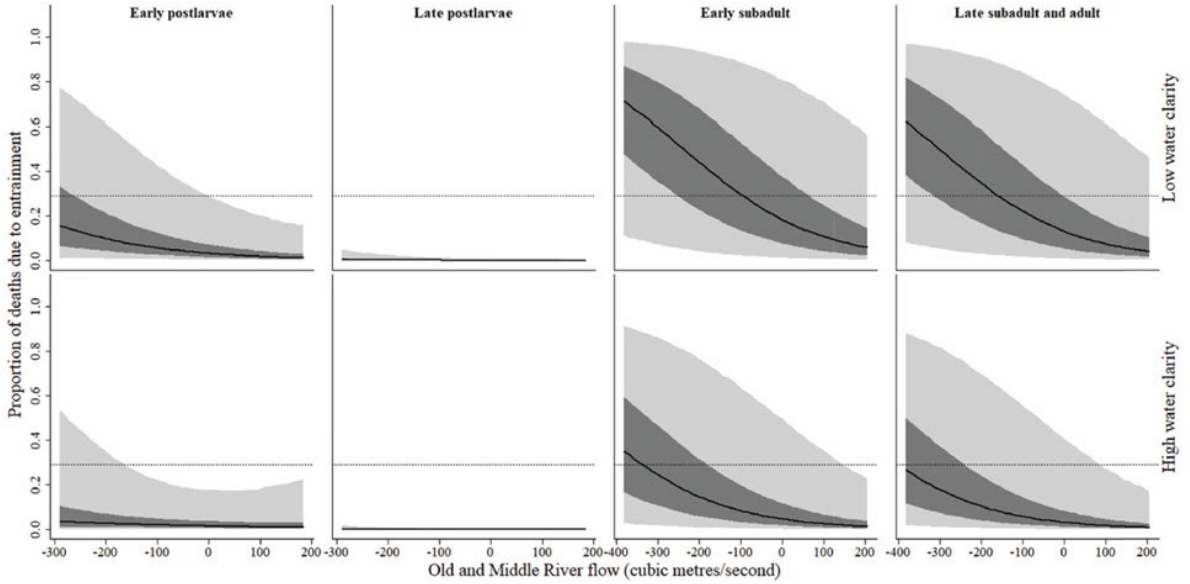
California Department of Fish and Wildlife (2024, Attachment 7:43–55) examined the relationship between the probability of adult White Sturgeon visiting spawning sites (based on acoustic telemetry) and White Sturgeon age, month, Delta outflow, Sacramento River flow, and X2. The best-fit model had White Sturgeon age as the most supported predictor but also included a positive relationship with Sacramento River flow with lag of 30 days, and the second and third best-fitting models included 30- and 60-day lagged Delta outflow. The probability of visiting spawning sites was higher in February than all months except March and April. Given 1) the overlap of February and 2) some evidence of flow, including Delta outflow, having a positive relationship with spawning site visitation, this suggests that there is potential for lower probability of adult White Sturgeon visiting spawning sites under First Flush Action OMR scenarios with lower Delta outflow (i.e., lower probability with OMR = -5,000 cfs than OMR = -3,500 cfs, and lower probability with OMR = -3,500 cfs than OMR = -2,000 cfs). However, given the range in Delta outflow that could occur (Table SUM1) and the nature of the statistical relationships found by California Department of Fish and Wildlife (2024, Attachment 7:49 [Figure 11]), the probability of visiting spawning sites would likely not be greatly different between OMR scenarios that could result from the updated decision-making approach to the First Flush Action.

2.2.2.2 Updated Decision-Making Approach to Adult Delta Smelt Entrainment Protection Action

Delta Smelt

With the updated decision-making approach to the Adult Delta Smelt Entrainment Protection Action, OMR could vary up to -5,000 cfs during the Action, which occurs after the First Flush Action and applies to the period up to March (or 53.6°F 3-day continuous water temperature at Jersey Point or Rio Vista). Based on the state-space life cycle model developed by Smith et al. (2021) for the historical wild population of Delta Smelt, OMR of -5,000 cfs (i.e., ~-140 cumecs) at high turbidity (i.e., low water clarity) could result in higher entrainment risk than OMR of -3,500 cfs [~-100 cumecs] (Figure DS3). Note that the analysis of Smith et al. (2021) used a model with a monthly time-step, whereas the Adult Delta Smelt Entrainment Protection Action is relatively limited in duration (i.e., initially 5 days), so that differences in December–February mean OMR between OMR scenarios resulting from different applications of the updated decision-making would be more

limited than the difference between -3,500 cfs and -5,000 cfs applied over several months, for example. Assessments will propose operational adjustments within boundaries no more negative than -5,000 cfs OMR. Assessments will include an evaluation of impacts to covered species by proposed operations, informed by available quantitative tools and real-time data, which may include entrainment and routing, modeling, distribution, and other real-time data, as appropriate.



Source: Smith et al. (2021). Note: For horizontal axis, range goes from -400 cumecs [~-14,000 cfs] to 200 cumecs [~7,000 cfs], with -100 cumecs = ~-3,500 cfs and -5,000 cfs = ~-140 cumecs]. The dark shaded regions indicate the interquartile range of posterior predictions, and the light shaded regions indicate the 95% credible intervals. The dotted horizontal lines indicate the reference point 0.41*natural mortality, or 0.29*total mortality, which represents a point beyond which Smith et al. (2021:1021) considered there to be high certainty of harm to the population.

Figure DS3. Posterior Distributions of Predicted Entrainment Mortality for Delta Smelt Early Postlarvae (April–May), Late Postlarvae (June), Early Subadult (December–January), and Late Subadult and Adult (February–March) at Two Levels of Water Clarity (2007–2015 Interquartile Range) and a Range of Old and Middle River Flows.

Longfin Smelt

Although OMR could vary up to -5,000 cfs as a result of the updated decision-making approach to the Adult Delta Smelt Entrainment Protection Action, as described for the First Flush Action, 2024 ITP COA would remain in place to limit the potential for changes to entrainment risk to adult Longfin Smelt (COA 8.3.3, Adult LFS Protection) and larval/juvenile Longfin Smelt (COA 8.4.2, Larval and Juvenile Longfin Smelt Entrainment Protection). These COAs would continue to minimize the risk to Longfin Smelt from SWP entrainment.

The Adult Delta Smelt Entrainment Protection Action temporally overlaps the winter-spring period noted to have positive correlations between Delta outflow and indices of Longfin Smelt abundance. As described previously for the First Flush Action, time periods considered in the ITP Application were March–May (which would not overlap the Adult Delta Smelt Entrainment Protection Action) and December–May, whereas the ITP Smelt Effects Analysis considered January–June. A -3,500-cfs OMR action would increase Delta outflow by less than 1,500 cfs relative to a -5,000-cfs OMR action because a given change in OMR can be achieved by reducing exports by around 0.91–0.94 of the

OMR change, depending on San Joaquin River at Vernalis flow and Grant Line Canal barrier status (Hutton 2008:10). Thus, for example, assuming Vernalis flow below 16,000 cfs and the Grant Line Canal Barrier not installed, a 5-day action of -5,000-cfs OMR would result in around 6.4 TAF more SWP exports than a -3,500-cfs OMR action, with the resulting 6.4-TAF reduction in Delta outflow being minor compared to overall Delta outflow of several thousand TAF during winter-spring (see Table LFS4). This indicates that differences in outflow between OMR scenarios that could occur under the updated decision-making approach to the Adult Delta Smelt Entrainment Protection Action would likely be a small percentage of total winter-spring Delta outflow and therefore unlikely to result in appreciable differences in Longfin Smelt abundance.

Winter-Run and Spring-Run Chinook Salmon

Although OMR could vary up to -5,000 cfs as a result of the updated decision-making approach to the Adult Delta Smelt Entrainment Protection Action, as described for the First Flush Action, 2024 ITP COA would remain in place to limit the potential for changes to entrainment risk to winter-run Chinook Salmon (COA 8.4.3, Winter-Run Chinook Salmon Annual Loss Thresholds, and COA 8.4.4, Natural-Origin Winter-Run Chinook Salmon Weekly Distributed Loss Thresholds) and spring-run Chinook Salmon (COA 8.4.5, Spring-Run Chinook Salmon Protection and Surrogate Annual Loss Thresholds). These COA, together with associated adaptive management, would continue to minimize the risk to winter-run and spring-run Chinook Salmon from SWP entrainment.

With respect to through-Delta survival, the previously described results of the ECO-PTM for salmon particles to assess the First Flush Action gave small differences between OMR scenarios of -3,500 cfs and -5,000 cfs (Figures CS1 and CS2). This is likely representative of the magnitude of differences that would be expected between these scenarios during the Adult Delta Smelt Entrainment Protection Action, indicating that there would not be expected to be considerable differences in through-Delta survival as a result of the updated decision-making approach to the Adult Delta Smelt Entrainment Protection Action. This is consistent with statistical relationships included in the Delta Passage Model, which do not support a negative effect of south Delta exports on survival of Chinook Salmon entering the interior Delta via Georgiana Slough or the Delta Cross Channel (ICF 2023, Appendix D:D-360). As previously described for the First Flush Action, the available information does not suggest there would be a negative effect on spring-run Chinook Salmon emigrating from the San Joaquin River basin as a result of higher exports (Figure CS3; Buchanan and Whitlock 2022).

White Sturgeon

Although OMR could vary up to -5,000 cfs as a result of the updated decision-making approach to the Adult Delta Smelt Entrainment Protection Action, as described for the First Flush Action, 2024 ITP COA would remain in place to limit the potential for changes to entrainment risk to White Sturgeon, i.e., COA 8.4.7 (White Sturgeon Entrainment Protection Action) and any eventual refinement to it through COA 8.4.8 (Evaluate and Develop Alternative White Sturgeon Entrainment Minimization During Real-Time OMR Management). These COA would continue to minimize the risk to White Sturgeon from SWP entrainment.

There are statistical relationships between Delta outflow and White Sturgeon year class strength and probability of adults visiting spawning sites, described in more detail for the First Flush Action discussed previously. As described for Longfin Smelt, differences in Delta outflow that could arise because of different OMR scenarios implemented under the updated decision-making approach to the Adult Delta Smelt Entrainment Protection Action would result in a minor differences to overall

Delta outflow and therefore would be unlikely to result in appreciable differences in White Sturgeon year class strength or probability of adults visiting spawning sites.

2.2.2.3 Updated Decision-Making Approach to Larval and Juvenile Delta Smelt Protection Action

Delta Smelt

With the updated decision-making approach to the Larval and Juvenile Delta Smelt Protection Action, OMR could vary up to -5,000 cfs during the Action, which occurs after the Adult Delta Smelt Entrainment Protection Action and applies to the end of the OMR management period in June. Based on the state-space life cycle model developed by Smith et al. (2021), OMR of -5,000 cfs (i.e., ∼-140 cumecs) at high turbidity (i.e., low water clarity) could result in an increase to entrainment relative to OMR of -3,500 cfs (i.e., ∼-100 cumecs) for the historical population (Figure DS3). As previously noted with respect to the Adult Delta Smelt Entrainment Protection Action, the analysis of Smith et al. (2021) used a model with a monthly time-step, whereas the Larval and Juvenile Delta Smelt Protection Action is relatively limited in duration (i.e., initially 7 days). Therefore, differences in mean OMR that could occur as a result of different OMR levels possible under the updated decision-making framework would be more limited than a difference of -3,500 cfs and -5,000 cfs over a one- or two-month averaging period. Assessments will propose operational adjustments within boundaries no more negative than -5,000 cfs OMR. Assessments will include an evaluation of impacts to covered species by proposed operations, informed by available quantitative tools and real-time data, which may include entrainment and routing, modeling, distribution, and other real-time data, as appropriate.

Longfin Smelt

Although OMR could vary up to -5,000 cfs as a result of the updated decision-making approach to the Larval and Juvenile Delta Smelt Protection Action, 2024 ITP COAs for Longfin Smelt would remain in place to limit the potential for changes to entrainment risk for adult Longfin Smelt (COA 8.3.3, Adult LFS Entrainment Protection) and, more likely to be relevant based on life stage timing, larval/juvenile Longfin Smelt (COA 8.4.2., Larval and Juvenile Longfin Smelt Entrainment Protection). These COAs would continue to minimize the risk to Longfin Smelt from SWP entrainment.

As described for the updated decision-making approach to the Adult Delta Smelt Entrainment Protection Action, there would be higher Delta outflow with a -3,500 cfs OMR Larval and Juvenile Delta Smelt Protection Action than with a -5,000 cfs OMR Larval and Juvenile Delta Smelt Protection Action, but the overall difference in Delta outflow would likely be a small percentage of total winter-spring Delta outflow and therefore unlikely to result in appreciable differences in Longfin Smelt abundance between OMR scenarios.

Winter-Run and Spring-Run Chinook Salmon

Although OMR could vary up to -5,000 cfs as a result of the updated decision-making approach to the Larval and Juvenile Delta Smelt Protection Action, 2024 ITP COA would remain in place to limit the potential for changes to entrainment risk to winter-run Chinook Salmon (COA 8.4.3, Winter-Run Chinook Salmon Annual Loss Thresholds, and COA 8.4.4, Natural-Origin Winter-Run Chinook Salmon Weekly Distributed Loss Thresholds) and spring-run Chinook Salmon (COA 8.4.5, Spring-

Run Chinook Salmon Protection and Surrogate Annual Loss Thresholds). These COA, together with associated adaptive management, would continue to minimize the risk to winter-run and spring-run Chinook Salmon from SWP entrainment.

With respect to through-Delta survival and as discussed for the Adult Delta Smelt Entrainment Protection Action, the previously described results of the ECO-PTM for salmon particles to assess the First Flush Action gave small differences between OMR scenarios of -3,500 cfs and -5,000 cfs (Figures CS1 and CS2). This is likely representative of the magnitude of differences that would be expected between these scenarios during the Larval and Juvenile Delta Smelt Protection Action, indicating that there would not be expected to be considerable differences in through-Delta survival as a result of the updated decision-making approach to the Larval and Juvenile Delta Smelt Entrainment Protection Action. As previously discussed, this is consistent with statistical relationships included in the Delta Passage Model, which do not support a negative effect of south Delta exports on survival of Chinook Salmon entering the interior Delta via Georgiana Slough or the Delta Cross Channel (ICF 2023, Appendix D:D-360). As previously described for the First Flush Action, the available information does not suggest there would be a negative effect on spring-run Chinook Salmon emigrating from the San Joaquin River basin as a result of higher exports (Figure CS3; Buchanan and Whitlock 2022).

White Sturgeon

Although OMR could vary up to -5,000 cfs as a result of the updated decision-making approach to the Larval and Juvenile Delta Smelt Protection Action, as described for the First Flush Action, 2024 ITP COA would remain in place to limit the potential for changes to entrainment risk to White Sturgeon, i.e., COA 8.4.7 (White Sturgeon Entrainment Protection Action) and any eventual refinement to it through COA 8.4.8 (Evaluate and Develop Alternative White Sturgeon Entrainment Minimization During Real-Time OMR Management). These COA would continue to minimize the risk to White Sturgeon from SWP entrainment.

There are statistical relationships between Delta outflow and White Sturgeon year class strength and probability of adults visiting spawning sites, described in more detail for the First Flush Action discussed previously. Differences in Delta outflow that could arise because of different OMR scenarios implemented under the updated decision-making approach to the Larval and Juvenile Delta Smelt Protection Action would result in a minor difference to overall Delta outflow and therefore would be unlikely to result in appreciable differences in White Sturgeon year class strength or probability of adults visiting spawning sites (see previous discussion for Longfin Smelt for additional context).

2.2.2.4 Significance of Impacts on Delta Smelt, Longfin Smelt, Winter-Run and Spring-Run Chinook Salmon, and White Sturgeon

Because the updated decision-making approach to the First Flush Action, Adult Delta Smelt Entrainment Protection Action, and Larval and Juvenile Delta Smelt Protection Action would have limited effects on south Delta entrainment risk and survival or abundance for Delta Smelt, Longfin Smelt, Winter-Run and Spring-Run Chinook Salmon, and White Sturgeon, impacts associated with this proposed change would be **less than significant**.

All other provisions of the ITP would remain in effect. No changes to SWP facilities or other operations are proposed and, thus, would have no impact on the species.

2.2.3 Analysis of Effects on Other Fish and Aquatic Species of Management Concern

Other fish and aquatic species were considered based on listing by federal agencies as endangered or threatened; California Species of Special Concern (critical, high, or moderate concern status); and species of Tribal, commercial, or recreational importance (2024 FEIR Table 6-1).

Federally listed species include Central Valley steelhead and Green Sturgeon. Updating of the decision-making approach to the First Flush Action, Adult Delta Smelt Entrainment Protection Action, and Larval and Juvenile Delta Smelt Protection Action could result in greater risk of south Delta entrainment to steelhead and Green Sturgeon during winter/spring as a result of more negative OMR scenarios that could result from the updated decision-making process, based on historical loss- or salvage-density data for the south Delta export facilities (2024 FEIR, Appendix 6B, Tables 6B-8 and 6B-10). However, steelhead entrainment risk would continue to be limited by existing OMR management (2024 FEIR pp. 2-29–2-30), which would not be subject to the updated decision-making process. Very few Green Sturgeon have been salvaged in the December–June period during which OMR scenarios could be affected by the updated decision-making process (2024 FEIR, Appendix 6B, Table 6B-10), so that differences in OMR would not give substantial differences in entrainment. In addition, SWP/CVP operations include a combined take limit for Green Sturgeon that is not to be exceeded (National Marine Fisheries Service 2024:900).

Non-listed fish and aquatic species for which south Delta entrainment risk tends to be greatest during the December–June period during which OMR could differ based on the updated decision-making process and which have had historical salvage greater than a small number of individuals include fall-run and late fall-run Chinook Salmon (2024 FEIR, Appendix 6B, Tables 6B-5 and 6B-6), lamprey (2024 FEIR, Appendix 6B, Table 6B-14), Sacramento Splittail (2024 FEIR, Appendix 6B, Table 6B-22), Striped Bass (2024 FEIR, Appendix 6B, Table 6B-26), and Largemouth Bass (2024 FEIR, Appendix 6B, Table 6B-32). As described in the FEIR, the effects on these species from differences in operational scenarios would tend to be limited because of ancillary effects of OMR flow management for listed species (in particular, management for listed salmonids in the case of fall-run and late fall-run Chinook Salmon; 2024 FEIR:6-245); south Delta entrainment not being a driver of population dynamics for Sacramento Splittail (2024 FEIR:6-285) or Striped Bass (2024 FEIR, Appendix 6A:6A-85); low population-level entrainment effect because of low population occurrence in the south Delta for lamprey (2024 FEIR:6-281); and occupancy of nearshore habitat probably providing a buffer from entrainment for Largemouth Bass (2024 FEIR:6-311).

Besides south Delta entrainment effects, more negative OMR scenarios during winter-spring that could result from the updated decision-making process could also affect steelhead and fall/late fall-run Chinook Salmon through-Delta survival by changing interior Delta flows and hydrodynamics. However, the results of the ECO-PTM and San Joaquin River Juvenile Chinook Salmon Through-Delta Survival (Structured Decision Model Routing Application) discussed previously for winter-run and spring-run Chinook Salmon indicate that there would not be a significant effect of the different OMR scenarios. Several other species have Delta outflow-abundance index relationships that overlap the winter/spring period, as described in the FEIR (i.e., Starry Flounder, Striped Bass, and American Shad), but there would not be significant effects of the different OMR scenarios based on the relatively limited magnitude of difference in Delta outflow summarized in the above discussions for outflow–abundance index effects on Longfin Smelt and White Sturgeon.

All other provisions of the 2024 LTO ITP would remain in effect. No changes to SWP facilities or other operations are proposed and, thus, would have no impact on other fish and aquatic species of management concern.

2.2.3.1 Significance of Impacts on Other Fish and Aquatic Species of Management Concern

Because the updated decision-making approach to the First Flush Action, Adult Delta Smelt Entrainment Protection Action, and Larval and Juvenile Delta Smelt Protection Action would have limited effects on south Delta entrainment risk and survival or abundance for other fish and aquatic species of management concern, impacts associated with this proposed change would be **less than significant**.

2.2.4 Cumulative Impacts

As described in the 2024 FEIR, the incremental contribution of the long-term operations of the SWP to the cumulative impact on aquatic and terrestrial biological resources would not be cumulatively considerable because the proposed SWP operations are subject to the same regulatory framework promulgated by the federal and state resource agencies, and include environmental commitments, conservation, or protective measures specifically intended to offset, reduce, or otherwise limit potential impacts on aquatic species. Because modification of ITP COAs 8.1.5 and 8.1.6 would not result in additional significant impacts on fish and aquatic species of management concern and DWR would continue to implement operational criteria and minimization/mitigation measures (e.g., as described in the 2024 FEIR and required by the 2024 SWP ITP), the long-term operation of the SWP would not result in cumulatively considerable impacts.

2.3 Conclusions

As described in this Addendum, the proposed change to COAs 8.1.5 and 8.1.6 of the 2024 LTO ITP does not require revisions to the conclusions or findings presented in the 2024 FEIR because no new or substantially more intense or severe significant environmental impacts, or potentially significant environmental impacts would occur.

Based on the discussion presented in Section 2.2, *Environmental Analysis*, the Proposed Project Description updates (i.e., changes to COAs 8.1.5 and 8.1.6 of the 2024 LTO ITP) would not result in any of the conditions described in Sections 15162 and 15163 of the State CEQA Guidelines that call for preparation of a subsequent EIR or supplemental EIR.

In summary, the proposed modifications to COAs 8.1.5 *Collaborative Approach to Real-time Decision Making* and 8.1.6, *Real-time Information Sharing Process,* of the 2024 LTO ITP would not result in any of the following:

- New significant or potentially significant environmental effects,
- Substantially increase the intensity or severity of previously identified significant effects,
- Mitigation measures or alternatives previously found to be infeasible becoming feasible, or

- Availability/implementation of mitigation measures or alternatives that are considerably different from those analyzed in the 2024 FEIR that would substantially reduce one or more significant or potentially significant effects on the physical environment.

These conclusions confirm that a subsequent or supplemental EIR is not warranted, and this Addendum to the 2024 FEIR is the appropriate CEQA document pursuant to State CEQA Guidelines Section 15164 to evaluate and document the changes and additions to the long-term operation of the SWP facilities in the Delta. No changes are needed to the certified 2024 FEIR for long-term operations of the SWP.

Chapter 3
References

3.1 Printed References

Buchanan RA and Whitlock SL. 2022. "Understanding Salmon Migration Dynamics in a Data-Limited Environment." North American Journal of Fisheries Management 42:1111-1133.

California Department of Fish and Wildlife. 2024. California Endangered Species Act Incidental Take Permit No. 2081-2023-054-00. Long-Term Operation of the State Water Project in the Sacramento-San Joaquin Delta. Sacramento, CA: Ecosystem Conservation Division.

California Department of Fish and Wildlife. 2025. Smelt Larva Survey Fish Distribution Map. Available: https://wildlife.ca.gov/Conservation/Delta/Smelt-Larva-Survey/Map Accessed: 30 October, 2025.

Costa, Vanessa. Senior Environmental Scientist, Specialist, State Water Project Permitting Unit, Ecosystem Conservation Division – Water Branch, California Department of Fish and Wildlife. June 19, 2024—Email containing coded wire tagged winter-run and spring-run Chinook Salmon loss data Excel file sent to Marin Greenwood, Aquatic Ecologist, ICF, Sacramento, CA.

Gilbert, MD, Malinich TD, Griffiths K, and Afentoulis V. 2025. Interagency Ecological Program San Francisco Estuary Larval Entrainment Study (LES) ver 3. Environmental Data Initiative. https://doi.org/10.6073/pasta/a93dd76415b1fddea768e67e9d672849 Accessed: 1 November, 2025.

Grimaldo LF, Smith WE, and Nobriga ML. 2021. "Re-Examining Factors That Affect Delta Smelt (Hypomesus transpacificus) Entrainment at the State Water Project and Central Valley Project in the Sacramento–San Joaquin Delta." San Francisco Estuary and Watershed Science 19.

Gross ES, Korman J, Grimaldo LF, MacWilliams ML, Bever AJ, and Smith PE. 2021. "Modeling Delta Smelt Distribution for Hypothesized Swimming Behaviors." San Francisco Estuary and Watershed Science 19.

Hutton, P. 2008. A Model to Estimate Combined Old & Middle River Flows. Final. April. Metropolitan Water District of Southern California.

ICF. 2023. Incidental Take Permit Application. Long-Term Operations of the State Water Project. November. (ICF 104469.0.014.01.). Prepared for the California Department of Water Resources, Sacramento, CA.

ICF. 2024. Long-term Operations of the State Water Project Incidental Take Permit White Sturgeon Supplement (No. 2081-2023-054-00). July. (ICF 104469.0.014.01.). Sacramento, CA. Prepared for California Department of Water Resources, Sacramento, CA.

National Marine Fisheries Service. 2024. Endangered Species Act Section 7(a)(2) Programmatic Biological Opinion for the Reinitiation of Consultation on the Long-Term Operation of the Central Valley Project and State Water Project. December 6. Long Beach, CA: National Marine Fisheries Service, West Coast Region.

Nguyen, Bryan. Senior Environmental Scientist (Specialist), Division of Integrated Science and Engineering, California Department of Water Resources, West Sacramento, California. May 20, 2025—Email containing tab-separated-value file with spring-run Chinook Salmon genetic identification data sent to Marin Greenwood, Aquatic Ecologist, ICF, Sacramento, CA.

Reece, Kevin. Environmental Program Manager, Water Initiatives Planning and Management Branch, Division of Operations and Maintenance, California Department of Water Resources, Sacramento, California. July 21 and September 1, 2023; May 13 and August 12, 2025—Emails containing Excel files with genetically identified and coded wire tagged winter-run and spring-run Chinook Salmon loss data sent to Marin Greenwood, Aquatic Ecologist, ICF, Sacramento, CA.

Smith WE, Polansky L, and Nobriga ML. 2021. "Disentangling risks to an endangered fish: using a state-space life cycle model to separate natural mortality from anthropogenic losses." Canadian Journal of Fisheries and Aquatic Sciences 78(8):1008–1029.

Smith, William. Statistician, San Francisco Bay-Delta Fish and Wildlife Office, US Fish and Wildlife Service, Sacramento, CA. November 17, 2025—Email containing plot of predicted Delta Smelt salvage versus Old and Middle River flow sent to Brian Schreier, Environmental Program Manager, California Department of Water Resources, West Sacramento, CA.

Tillotson MD, Hassrick J, Collins AL, and Phillis C. 2022. "Machine Learning Forecasts to Reduce Risk of Entrainment Loss of Endangered Salmonids at Large-Scale Water Diversions in the Sacramento–San Joaquin Delta, California." San Francisco Estuary and Watershed Science 20.

Wang X, Perry RW, Pope AC, and Jackson D. 2024. "Individual-Based Ecological Particle Tracking Model (ECO-PTM) for Simulating Juvenile Chinook Salmon Migration and Survival Through the Sacramento–San Joaquin Delta." San Francisco Estuary and Watershed Science 22.