

Draft Proposed BDCP Near-Term Conservation Measures for Hydrodynamic Modeling and Analysis
Draft - September 3, 2009

***Note to Reviewers:** This table provides a summary of proposed near-term Delta conservation measures, including near-term water operations, habitat actions and other measures, for the purpose of conducting the BDCP effects analysis. It was prepared by the SAIC consultant team at the request of the BDCP Steering Committee. Information in this table provides the basis for hydrologic and hydrodynamic modeling inputs for the effects analyses, the information from which will then be used to refine the current draft of Chapter 3 of the BDCP as the planning process progresses over the course of the fall.*

This proposal is intended to assist in modeling and analytical purposes only. This proposal does not supersede or otherwise reflect upon the adequacy of existing regulatory requirements pertaining to the operations of the State Water Project or the Central Valley Project.

In conjunction with this modeling and analytical work now underway in support of the BDCP planning process, the Steering Committee is also developing a comprehensive set of metrics that will be used to track the effectiveness of the conservation measures of the BDCP in achieving the near-term and long-term biological goals and objectives of the BDCP. These metrics are being developed and evaluated by a working group of technical experts, assisted by the SAIC team, and may be assisted by additional scientific input at the election of the BDCP Steering Committee as the work progresses. These metrics will be incorporated into the BDCP conservation strategy over the course of the fall 2009.

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Biological Objectives	Biological Opinion RPA Actions ¹	Applicable BDCP Conservation Measures	BDCP Benefits, Expected Outcomes, Monitoring, and Metrics	BDCP Proposed Initial Near-Term Water Operations Assumptions ²
1. Increase the protection of pre-spawning adults from entrainment during the first flush by providing advantageous hydrodynamic conditions early in the migration period.	December 1 to December 20. OMR flows >-2000 cfs (14 day running average) with simultaneous 5-day within 25% of flow requirement for 14 days.	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 	<p>Benefits: Conservation measures complement the intent of the objective by increasing delta smelt survival and suitability of spawning habitats by providing favorable hydrodynamic conditions early in the adult upstream migration period.</p> <p>Expected Outcomes: Increased survival of delta smelt pre-spawning adults and increased annual abundance of spawning adults.</p> <p>Monitoring: Implementation of predictive adult smelt modeling with skill-based assessments over the next 2 years. Real-time turbidity monitoring at locations throughout the south and central Delta. Delta and longfin smelt geographic distribution as reflected in the fall mid water trawl and Kodiak trawl surveys.</p> <p>Metrics: Implementation of monitoring program and demonstrable predictive skill of adult smelt modeling (timing). Reduce/avoid delta smelt and longfin smelt entrainment. Application of the Potential Entrainment Index (PEI) model.</p>	<p>Reduce OMR flows >-2000 cfs if south Delta turbidity >12 NTU in Old or Middle River or pre-spawning adult delta or longfin smelt are observed in SWP or CVP salvage on 3 consecutive days. Implement real-time turbidity monitoring and implement short-term reductions in exports to avoid movement of adults into the southern Delta based on predictions of delta smelt modeling and PEI. With successful implementation of these programs, it is anticipated that the objectives could be satisfied more efficiently with targeted short-term modifications of project operations determined from monitoring and predictive modeling. OMR restrictions are anticipated to occur for a shorter duration during this period than under the RPA.</p> <p>Two Gates Install and operate gates at Old River and Connection Slough (“Two Gates”) to reduce the transport of covered species into the interior Delta and improve water quality in the south and central Delta. Operate Two Gates as part of real-time monitoring and adaptive management to reduce take.</p>

¹ Column 2 contains a paraphrased interpretation of the contents of the USFWS and NMFS Biological Opinions RPA Actions.

² Column 5 presents a proposed initial near-term operation. It is anticipated that additional operational changes may be made over the course of the near term through adaptive management.

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<p>2. Increase the suitability of Delta spawning habitat by protecting from entrainment pre-spawning adults that have migrated upstream and are residing in the Delta.</p>	<p>December 20 until delta smelt spawning. OMR flows >-1250 to -5000 cfs (14 day running average) according to SWG recommendation based on turbidity and flow. Management would primarily focus on pre-spawning adult delta and longfin smelt.</p>	<ul style="list-style-type: none"> ■ See Proposed Operations in column 5 ■ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ■ OSCM 10: Reduce non-native introductions from recreational watercraft. ■ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ■ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. ■ HRCM 4: Restore at least 5,000 acres of tidal habitat within the Cache Slough complex which would provide additional habitat for delta smelt spawning. ■ HRCM 9: Restore at least 7,000 acres of tidal habitat within Suisun Marsh which will provide additional habitat for delta smelt spawning. 	<p>Benefits: Conservation measures complement the intent of the objectives by increasing delta smelt survival and suitability of spawning habitats by reducing effects of: toxics on fish and food supply, predation, and non-project entrainment.</p> <p>Expected Outcomes: Increased annual abundance of spawning delta and longfin smelt adults.</p> <p>Monitoring: Implementation of predictive adult smelt modeling with skill-based assessments over the next 2 years. Real-time turbidity monitoring at locations throughout the south and central Delta. Delta and longfin smelt geographic distribution as reflected in the fall mid water trawl and Kodiak trawl surveys.</p> <p>Metrics: Implementation of monitoring program and demonstrable predictive skill of adult smelt modeling (timing). Reduce/avoid delta smelt and longfin smelt entrainment. Application of the Potential Entrainment Index (PEI) model.</p>	<p>Export Operations Preferential export operations from the CVP Jones facility to reduce pre-screen predation losses within Clifton Court Forebay. Consider operating Clifton Court Forebay radial gates in the open position from December 1 to June 30. Improve fish salvage operations and release locations. These export operations would apply only when OMR restrictions are controlling.</p> <p>Combined Old and Middle River Flows Prescribed range of OMR flows based on FWS smelt BO and NMFS salmon BO model of adaptive restrictions. However, the operational criteria will be fixed within ranges in the BO and adjusted on a real-time basis.</p> <p><i>* The operational criteria can be adjusted based on real time monitoring up or down by the Fishery Agencies provided there is no net water supply costs from this regulatory baseline by the time of low-point in San Luis Reservoir (typically late August or early September) unless prior agreement is obtained from SWP and CVP related to carryover debt or credits.</i></p> <p>Table below represents current estimate of “most likely” OMR restrictions under combination of FWS smelt BO, NMFS salmon BO, and longfin smelt for modeling purposes</p> <table border="1" data-bbox="2293 854 2815 1382"> <thead> <tr> <th colspan="6">Combined Old and Middle River flows no less than values below* (cfs)</th> </tr> <tr> <th>Month</th> <th>W</th> <th>AN</th> <th>BN</th> <th>D</th> <th>C</th> </tr> </thead> <tbody> <tr><td>Jan</td><td>-4000</td><td>-4000</td><td>-4000</td><td>-5000</td><td>-5000</td></tr> <tr><td>Feb</td><td>-5000</td><td>-4000</td><td>-4000</td><td>-4000</td><td>-4000</td></tr> <tr><td>Mar</td><td>-5000</td><td>-4000</td><td>-4000</td><td>-3500</td><td>-3000</td></tr> <tr><td>Apr</td><td>-5000</td><td>-4000</td><td>-4000</td><td>-3500</td><td>-2000</td></tr> <tr><td>May</td><td>-5000</td><td>-4000</td><td>-4000</td><td>-3500</td><td>-2000</td></tr> <tr><td>Jun</td><td>-5000</td><td>-5000</td><td>-5000</td><td>-5000</td><td>-2000</td></tr> <tr><td>Jul</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr> <tr><td>Aug</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr> <tr><td>Sep</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr> <tr><td>Oct</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr> <tr><td>Nov</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr> <tr><td>Dec</td><td>-6800</td><td>-6800</td><td>-6300</td><td>-6300</td><td>-6100</td></tr> </tbody> </table> <p><i>* Values are monthly average for use in modeling. December 20-31 targets are -5000 cfs (W, AN), -3500 cfs (AN, D), and -3000 cfs (C), and are averaged with an assumed background of -8000 cfs for December 1-19. Values are reflective of the “most likely” operation under the FWS Delta Smelt Biological Opinion. Values for modeling may be updated based on review by fishery agencies.</i></p> <p>Two Gates Install and operate gates at Old River and Connection Slough (“Two Gates”) to reduce the transport of covered species into the interior Delta and improve water quality in the south and central Delta. Operate Two Gates as part of real-time monitoring and adaptive management to reduce take.</p>	Combined Old and Middle River flows no less than values below* (cfs)						Month	W	AN	BN	D	C	Jan	-4000	-4000	-4000	-5000	-5000	Feb	-5000	-4000	-4000	-4000	-4000	Mar	-5000	-4000	-4000	-3500	-3000	Apr	-5000	-4000	-4000	-3500	-2000	May	-5000	-4000	-4000	-3500	-2000	Jun	-5000	-5000	-5000	-5000	-2000	Jul	N/A	N/A	N/A	N/A	N/A	Aug	N/A	N/A	N/A	N/A	N/A	Sep	N/A	N/A	N/A	N/A	N/A	Oct	N/A	N/A	N/A	N/A	N/A	Nov	N/A	N/A	N/A	N/A	N/A	Dec	-6800	-6800	-6300	-6300	-6100
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<p>3. Increase the suitability of Delta habitat and reduce entrainment losses of larval and juvenile delta and longfin smelt, Chinook salmon, and steelhead during the late winter and spring</p>	<p>Presence of larval delta smelt until June 30. OMR flows >-1250 to -5000 cfs (14 day running average) according to SWG recommendation based on sampling, salvage, and expertise. Operations would also be intended to reduce the risk of entrainment of Chinook salmon and steelhead.</p>	<ul style="list-style-type: none"> ■ See Proposed Operations in column 5 ■ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ■ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ■ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ■ HRCM 4: Restore at least 5,000 acres of tidal habitat within the Cache Slough complex which would provide additional habitat for delta smelt rearing as well as additional food supplies ■ HRCM 9: Restore at least 7,000 acres of tidal habitat within Suisun Marsh which will provide additional habitat for delta smelt spawning ■ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ■ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. ■ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. 	<p>Benefit: Reduce entrainment of larval and juvenile delta and longfin smelt, Chinook salmon, and steelhead and thereby increase the overall survival and population abundance of covered fish species. Minimize the number of larval delta smelt at facilities by managing hydrodynamics in the central Delta to increase the larval and juvenile rearing success and downstream transport. Conservation measures complement the intent of the objectives increasing delta smelt in-Delta rearing success by reducing effects of toxics on fish and food supply, predation, and non-project entrainment.</p> <p>Expected Outcomes: Greater survival of larval and juvenile smelt, Chinook salmon, and steelhead and subsequent adult recruitment.</p> <p>Monitoring: Implementation of predictive adult smelt modeling with skill-based assessments over the next 2 years. Real-time turbidity monitoring at locations throughout the south and central Delta. Delta and longfin smelt geographic distribution as reflected in the fall mid water trawl and Kodiak trawl surveys. Juvenile salmon monitoring in the tributaries for use as a basis to modify operations. Occurrence of juvenile salmon and steelhead in salvage.</p> <p>Metrics: Implementation of monitoring program and demonstrable predictive skill of adult smelt modeling (timing). Reduce/avoid delta smelt and longfin smelt entrainment. Application of the Potential Entrainment Index (PEI) model.</p>	<p>Export Operations Preferential export operations from the CVP Jones facility to reduce pre-screen predation losses within Clifton Court Forebay. Consider operating Clifton Court Forebay radial gates in the open position from December 1 to June 30. Improve fish salvage operations and release locations. These export operations would apply only when OMR restrictions are controlling.</p> <p>Migration Barriers Install and operate behavioral barriers to juvenile fish movement at the Head of Old River, Georgiana Slough, Turner Cut, Columbia Cut from January 15 through June 30</p> <p>Combined Old and Middle River Flows Prescribed range of OMR flows based on FWS smelt BO and NMFS salmon BO model of adaptive restrictions. However, the operational criteria will be fixed within ranges in the BO and adjusted on a real-time basis.</p> <p><i>* The operational criteria can be adjusted based on real time monitoring up or down by the Fishery Agencies provided there is no net water supply costs from this regulatory baseline by the time of low-point in San Luis Reservoir (typically late August or early September) unless prior agreement is obtained from SWP and CVP related to carryover debt or credits.</i></p> <p>Table below represents current estimate of “most likely” OMR restrictions under combination of FWS smelt BO, NMFS salmon BO, and Longfin smelt for modeling purposes</p> <table border="1" data-bbox="2293 909 2818 1435"> <thead> <tr> <th colspan="6">Combined Old and Middle River flows no less than values below* (cfs)</th> </tr> <tr> <th>Month</th> <th>W</th> <th>AN</th> <th>BN</th> <th>D</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>Jan</td> <td>-4000</td> <td>-4000</td> <td>-4000</td> <td>-5000</td> <td>-5000</td> </tr> <tr> <td>Feb</td> <td>-5000</td> <td>-4000</td> <td>-4000</td> <td>-4000</td> <td>-4000</td> </tr> <tr> <td>Mar</td> <td>-5000</td> <td>-4000</td> <td>-4000</td> <td>-3500</td> <td>-3000</td> </tr> <tr> <td>Apr</td> <td>-5000</td> <td>-4000</td> <td>-4000</td> <td>-3500</td> <td>-2000</td> </tr> <tr> <td>May</td> <td>-5000</td> <td>-4000</td> <td>-4000</td> <td>-3500</td> <td>-2000</td> </tr> <tr> <td>Jun</td> <td>-5000</td> <td>-5000</td> <td>-5000</td> <td>-5000</td> <td>-2000</td> </tr> <tr> <td>Jul</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Aug</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Sep</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Oct</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Nov</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Dec</td> <td>-6800</td> <td>-6800</td> <td>-6300</td> <td>-6300</td> <td>-6100</td> </tr> </tbody> </table> <p><i>* Values are monthly average for use in modeling. 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4. Maintain flow in the lower Sacramento River (Rio Vista) to maintain water quality and fish habitat	None	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 	<p>Benefit: Maintain water quality conditions and lower Sacramento River flows throughout the year. Provide upstream attraction flows and olfactory cues for adult salmon and steelhead migration into the Sacramento River.</p> <p>Expected Outcomes: Maintain suitable water quality and habitat conditions for resident and migratory fish within the lower Sacramento River.</p> <p>Monitoring: Monitor water quality conditions within the lower Sacramento River in the vicinity of Rio Vista including EC, temperature, and turbidity. Acoustic tagging of upstream migrating adult Chinook salmon in the fall to determine attraction and migration rate.</p> <p>Metrics: Measured tidally average net river flow at Rio Vista; water quality parameters including dissolved oxygen concentrations</p>	D-1641 requirement
5. Maintain low salinity estuarine habitat within Suisun Bay and the western Delta during the winter and spring	None	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ▪ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ▪ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ▪ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ▪ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. ▪ HRCM 9: Restore at least 7,000 acres of tidal aquatic habitat within Suisun Marsh that is expected to provide habitat for delta smelt and other estuarine fish as well as increase their food supplies ▪ HRCM 4: Restore at least 5,000 acres of tidal habitat within the Cache Slough complex which would provide additional habitat for delta smelt rearing as well as additional food supplies 	<p>Benefit: Provide low salinity habitat within Suisun Bay and the western Delta to benefit estuarine processes and provide habitat for resident and migratory fish and other aquatic species. Transport fish eggs and larvae downstream into Suisun Bay to increase their co-occurrence with suitable food supplies and support a geographic distribution that serves to reduce the risk of entrainment at the SWP and CVP export facilities and other in-Delta points of diversion. Provide net downstream flow cues for the migration of juvenile fish such as Chinook salmon and steelhead and provide suitable water quality conditions for adult and juvenile fish such as sturgeon. Conservation measures complement the intent of the objectives to reduce effects of toxics on fish and food supply, predation, and non-project entrainment.</p> <p>Expected Outcomes: Greater survival of larval and juvenile smelt, Chinook salmon, and steelhead and subsequent adult recruitment.</p> <p>Monitoring: Estimated location of X2 position; geographic distribution and densities of larval and juvenile fish based on results of the longfin smelt larval survey, 20 mm delta smelt survey, summer townet survey, and fall mid water trawl survey; comparative estimates of the abundance indices for covered fish; estimates of the survival and migration rates of juvenile salmon and steelhead.</p> <p>Metrics: Changes in the geographic distribution and densities of covered fish; abundance indices; survival estimates for juvenile salmon and steelhead.</p>	D-1641 X2 requirements managed as an average over the 5-month-period (Feb-Jun) to better reflect the original basis from which X2 was derived and to avoid adverse upstream operations for anadromous species (stranding, redd dewatering, and coldwater pool).

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<p>6. Increase the abundance of delta smelt through reduced risk of entrainment in the fall, reduced exposure to predation and toxic contaminants, and increase the availability of suitable habitat for delta smelt within the low salinity zone of the estuary during the fall.</p>	<p>Maintain monthly average X2 no greater than 74 km in wet and 81 km in above normal years, separately for September and October</p>	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ▪ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ▪ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ▪ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ▪ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. ▪ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. ▪ HRCM 4: Restore at least 5,000 acres of tidal habitat within the Cache Slough complex which would provide additional habitat for delta smelt rearing as well as additional food supplies ▪ HRCM9: Restore at least 7,000 acres of brackish tidal marsh within the Suisun Marsh Restoration Opportunity Area. 	<p>Benefits: Improve fall habitat by managing fall X2 and expansion of suitable aquatic habitat outside of regions of high entrainment risk. Conservation measures will also reduce risks of non-project entrainment and reduce exposure to toxics and predation within the Delta, addressing these purposes for moving X2 westward. Restoration of estuarine habitat within Suisun Marsh and West Delta (i.e., tidal and subtidal components of marsh restoration) will increase habitat within areas of existing suitable salinities addressing the need for expanding suitable habitat area.</p> <p>Expected Outcomes: Increased survival and abundance of adult smelt and the following years spawning population.</p> <p>Monitoring: Geographic distribution on densities of pre-spawning delta smelt within Suisun Bay and the Delta based on results of the fall mid water trawl and Kodiak trawl surveys. Habitat area and volume meeting suitability criteria for delta smelt. Relationship between habitat conditions and delta smelt spawning abundance, distribution, and success</p> <p>Metrics: Habitat use by delta smelt and geographic distribution within Suisun Bay and the Delta; change in delta smelt pre-spawning survival and abundance; change in delta smelt spawning success; change in geographic distribution and survival of other covered fish such as longfin smelt..</p>	<p>Provide experimental fall X2 flows in September-October through re-operations of excess flood flows that will not cause an overall water supply impact to the SWP or CVP beyond that agreed to in advance by the PREs. Fall reservoir releases for the purpose of X2 experimentation would not exceed average seasonal reservoir inflow or releases from reservoir storage. The experimental fall X2 tests are considered to be part of the BDCP adaptive management program.</p> <p>The experimental fall X2 tests will be used to evaluate the biological benefits to delta smelt and other species of fall X2 flows in comparison to increased aquatic habitat within Suisun Marsh and the western Delta.</p>
<p>7. Improve survival of juvenile Chinook salmon and steelhead while not increasing the risk of entrainment of larval and juvenile delta and longfin smelt at the SWP and CVP export facilities or adversely modifying their geographic distribution within Delta.</p>	<ul style="list-style-type: none"> ▪ Do not install HORB if delta smelt entrainment is a concern. ▪ If HORB not installed, temporary ag barriers would be installed. If HORB installed, temporary barriers must be open until May 15. 	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ▪ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ▪ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ▪ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ▪ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. ▪ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. ▪ OSCM25: Improve the survival of outmigrating juvenile salmonids by using non-physical barriers to re-direct them away from channels in which survival is lower. (install non-physical behavioral barriers to juvenile salmon and steelhead migration at the Head Of Old River (HORB) from January 15 through June 15) 	<p>Benefits: Reduce the risk of juvenile Chinook salmon and steelhead losses as a result of SWP and CVP export operations and maintain downstream migration within the lower reaches of the San Joaquin River; reduce the influence of export operations interacting with physical barriers that increase the risk of entrainment of larval and juvenile delta and longfin smelt or an adverse change in Delta hydraulics that modifies the geographic distribution and dispersal of early lifestages of delta and longfin smelt. Conservation measures reduce risks of non-project entrainment and reduce exposure to toxics and predation within the Delta.</p> <p>Expected Outcomes: Increased survival and abundance of adult smelt and the following years spawning population; reduced entrainment and salvage; increased survival of outmigrating juvenile Chinook salmon and steelhead.</p> <p>Monitoring: Geographic distribution of densities of larval and juvenile delta and longfin smelt within Suisun Bay and the Delta based on results of the CDFG longfin smelt surveys and 20 mm delta smelt surveys; survival estimates for juvenile salmon and steelhead; monitoring of migration routes for juvenile salmon and steelhead to determine the effectiveness of the barrier and migration timing and pathways.</p> <p>Metrics: Habitat use by delta smelt and geographic distribution within Suisun Bay and the Delta; change in delta smelt pre-spawning survival and abundance; change in delta smelt spawning success; change in geographic distribution and survival of other covered fish such as longfin smelt</p>	<p>Install temporary ag barriers with gate closure after May 15.</p>

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<p>8. Increase the quality and availability of tidal and subtidal aquatic habitat that is suitable for various life stages of covered fish and increase the production and availability of organic carbon, phytoplankton, and zooplankton that serve as the base of the estuarine trophic food web</p>	<p>Create 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh</p>	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ HRCMs 4, 6, and 9: Restore 14,000 acres of tidal marsh habitats primarily in Cache Slough, Suisun Marsh, and the west Delta ▪ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ▪ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ▪ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ▪ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. 	<p>Benefits: Improve habitat conditions for delta smelt and other aquatic species by enhancing food production and increasing habitat quality and availability. Conservation measures complement the intent of the objective by increasing food supply and availability by restoring an additional 6,000 acres of estuarine habitat to increase food production, reducing entrainment of food from non-project diversions, and decreasing effects of toxics on food production and supply.</p> <p>Expected Outcomes: Increased growth, survival, population abundance, and reproductive success of delta smelt and other covered fish species.</p> <p>Monitoring: Geographic distribution of densities of larval and juvenile delta and longfin smelt within Suisun Bay and the Delta based on results of the CDFG longfin smelt surveys and 20 mm delta smelt surveys; survival estimates for juvenile salmon and steelhead; monitoring of migration routes for juvenile salmon and steelhead to determine the effectiveness of the barrier and migration timing and pathways.</p> <p>Metrics: Habitat use by delta smelt and geographic distribution within Suisun Bay and the Delta; change in delta smelt pre-spawning survival and abundance; change in delta smelt spawning success; change in geographic distribution and survival of other covered fish such as longfin smelt.</p>	<p>N/A (habitat restoration measures only)</p>
<p>9. Reduce delays in upstream and downstream migration by adult and juvenile fish; reduce vulnerability to harvest; improve survival</p>	<p>Reduce migratory delays and loss of juvenile and adult salmonids and sturgeon at Fremont Weir and other structures in Yolo Bypass.</p>	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 	<p>Benefits: Reduce migratory delays and loss of adult and juvenile winter-run and spring-run Chinook salmon, steelhead, and green sturgeon at Fremont Weir and other structures in the Yolo Bypass. Fremont Weir and Lisbon Weir improvements are comparable to some of the RPA actions.</p> <p>Expected Outcomes: Increased passage of adults through the Yolo Bypass to upstream spawning habitats.</p> <p>Monitoring: Migration rates and delays in migration of adult and juvenile fish passing the Fremont Weir.</p> <p>Metrics: Estimates of the numbers of each species and lifestage of fish passing through the ladder; flow and ladder operations; performance of the ladder relative to the design criteria; rate of fish passage upstream and downstream.</p>	<p>Modified Fremont Weir and Control Gate and Improve Passage</p> <ul style="list-style-type: none"> • Spills into Yolo Bypass enabled at water surface elevation 17.5 ft NAVD88 (~15,000 cfs Sac R at Fremont flow) by notch and new gates, as compared to current weir elevation of 33.5 ft (~56,000 cfs Fremont flow). • Flows: 2,000-6,000 cfs* depending on hydrology • Duration: 30-45 days • Period: Gates operable December – April 15 (occasionally April 16-May 15 depending of hydrologic conditions) <p>* Flows less than 3,000 cfs may require physical modifications to the Yolo Bypass and toe drain to achieve levels of desired floodplain habitat.</p> <p>** Physical modifications to Yolo Bypass and the toe drain may be required to achieve levels of desired floodplain habitat enhancement.</p> <p>Construct and operate a fish ladder and passage system at the Fremont Weir designed to pass adult and juvenile salmon, steelhead, sturgeon, and other fish.</p> <p>Modify Lisbon Weir to improve fish passage.</p> <p>Improve physical habitat in Lower Putah Creek.</p>
<p>10. Improve survival of juvenile Chinook salmon</p>	<p>Monitoring and alters to trigger changes in DCC operations</p>	<ul style="list-style-type: none"> ▪ BDCP Monitoring and Research Program 	<p>Benefits: Reduce exposure of emigrating juvenile salmonids to stressors, entrainment, predation, and exposure to contaminants within the interior Delta</p> <p>Expected Outcomes: improved survival of emigrating juvenile salmonids.</p> <p>Monitoring: Change in juvenile salmonid abundance at upstream monitoring locations, change in turbidity, change in river and tributary flows during emigration period</p> <p>Metrics: Effectiveness in reducing migration from the Sacramento River into the interior Delta; improvement of juvenile salmonid survival.</p>	<p>Same as NMFS RPA</p>

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Biological Objectives	Biological Opinion RPA Actions ¹	Applicable BDCP Conservation Measures	BDCP Benefits, Expected Outcomes, Monitoring, and Metrics	BDCP Proposed Initial Near-Term Water Operations Assumptions ²
11. Improve survival of juvenile salmonids	Consider engineering solutions to further reduce diversion of juvenile salmonids into the interior and south Delta and exposure to export facilities	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ▪ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. ▪ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. ▪ OSCM25: Improve the survival of outmigrating juvenile salmonids by using non-physical barriers to re-direct them away from channels in which survival is lower. (including installation of behavioral barriers at strategic locations including Head of Old River, Columbia and Turner Cuts, and Georgiana Slough) 	<p>Benefits: Reduce exposure of emigrating juvenile salmonids to stressors, entrainment, predation, and exposure to contaminants within the interior Delta.</p> <p>Expected Outcomes: Improved survival of emigrating juvenile salmonids.</p> <p>Monitoring: Change in numbers of juvenile salmonids migrating into the interior Delta; change in overall juvenile salmonid survival.</p> <p>Metrics: Effectiveness in reducing migration from the Sacramento River into the interior Delta; improvement of juvenile salmonid survival.</p>	N/A (other stressors measures only)
12. Improve survival of juvenile salmonids emigrating from the San Joaquin River	San Joaquin River inflow to export ratio	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ OSCM25: Improve the survival of outmigrating juvenile salmonids by using non-physical barriers to re-direct them away from channels in which survival is lower. (including installation of behavioral barriers at strategic locations including Head of Old River, Columbia and Turner Cuts). 	<p>Benefits: Reduce the vulnerability of juvenile steelhead within the lower San Joaquin River to entrainment into the channels of the south Delta and at the export pumps exposure of emigrating juvenile salmonids to stressors, entrainment, predation, and exposure to contaminants within the interior Delta.</p> <p>Expected Outcomes: Improved survival of emigrating juvenile steelhead.</p> <p>Monitoring: Change in the migration rate and pathways for juvenile steelhead; change in juvenile steelhead survival.</p> <p>Metrics: Effectiveness in reducing migration from the San Joaquin River into the interior Delta; improvement of juvenile steelhead survival.</p>	Export operations during the salmonid emigration period in accordance with OMR criteria described in Row 3.
13. Improve understanding on juvenile salmonid emigration rates and pathways and their survival	Six year acoustic tag experiment on steelhead within the San Joaquin River	<ul style="list-style-type: none"> ▪ BDCP Monitoring and Research Program (implement an acoustic tag experiment to assess migration and survival of juvenile salmonids). 	<p>Benefits: Improve understanding of migration rates and pathways as well as survival within various reaches of the rivers and Delta; evaluate the effectiveness of specific conservation actions in achieving the desired objectives; improve the scientific understanding of fish behavior, sources of mortality, and identify potential additional opportunities to improve survival by reducing sources of mortality.</p> <p>Expected Outcomes: Improved scientific understanding of the process and factors affecting survival of emigrating juvenile salmonids.</p> <p>Monitoring: Change in the migration rate and pathways for juvenile steelhead; change in juvenile steelhead survival.</p> <p>Metrics: Effectiveness in reducing migration from the San Joaquin River into the interior Delta; improvement of juvenile steelhead survival.</p>	N/A (Monitoring and Research Program)

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<p>14. Provide resources to maintain and enhance habitat conditions for Central Valley salmonids and other anadromous fish</p>	<p>Funding for CVPIA AFSP</p>	<ul style="list-style-type: none"> ■ See Proposed Operations in column 5 ■ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. ■ OSCM 24: Reduce the effects of predators on covered fish by conducting localized predator control at locations where predation mortality is high ■ HRCMs 4, 6, and 9: Restore 14,000 acres of tidal marsh habitats primarily in Cache Slough, Suisun Marsh, and the west Delta]. ■ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ■ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ■ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. 	<p>Benefits: Improve habitat quality and availability within various regions of the Central Valley for anadromous fish. Conservation measures complement the objective by reducing entrainment of juvenile anadromous fish at Delta non-project diversions.</p> <p>Expected Outcomes: Increased survival and abundance of juvenile anadromous fish.</p> <p>Monitoring: Abundance and density of adult Chinook salmon; estimated abundance and survival of juvenile salmonids.</p> <p>Metrics: Adult salmon escapement and spawning; juvenile densities, abundance, growth, and survival; suitability of physical habitat conditions.</p>	<p>None: BDCP actions would be complementary to AFSP actions.</p>
<p>15. Improve access, habitat quality and availability for juvenile salmon and steelhead rearing, increase growth and survival, and contribute to increased abundance</p>	<p>Sacramento River basin salmonid rearing habitat improvements</p>	<ul style="list-style-type: none"> ■ See Proposed Operations in column 5 ■ HRCM4: Restore at least 5,000 acres freshwater tidal marsh within the Cache Slough Complex ROA 	<p>Benefits: Restore floodplain rearing habitat for juvenile Chinook salmon in the lower Sacramento River Basin. Enhance seasonally inundated floodplain rearing habitat in the Yolo Bypass. Implement Putah Creek and Lisbon Weir improvements as part of these RPA actions. Tidal marsh restoration will complement the objective by restoring estuarine rearing habitat connected to the lower Yolo Bypass floodplain habitats.</p> <p>Expected Outcomes: Increased growth and survival of juvenile salmonids and upstream passage of fall-run Chinook salmon into Putah Creek.</p> <p>Monitoring: Abundance and density of adult Chinook salmon; estimated abundance and survival of juvenile salmonids; passage delays for upstream and downstream migration; reproduction by splittail and other fish; change in food production.</p> <p>Metrics: Adult salmon escapement and spawning; juvenile densities, abundance, growth, and survival; suitability of physical habitat conditions.</p>	<p>Modified Fremont Weir and Control Gate and Improve Passage</p> <ul style="list-style-type: none"> • Spills into Yolo Bypass enabled at water surface elevation 17.5 ft NAVD88 (~15,000 cfs Sac R at Fremont flow) by notch and new gates, as compared to current weir elevation of 33.5 ft (~56,000 cfs Fremont flow). • Flows: 2,000-6,000 cfs* depending on hydrology • Duration: 30-45 days • Period: Gates operable December – April 15 (occasionally April 16-May 15 depending of hydrologic conditions) <p>* Flows less than 3,000 cfs may require physical modifications to the Yolo Bypass and toe drain to achieve levels of desired floodplain habitat.</p> <p>** Physical modifications to Yolo Bypass and the toe drain may be required to achieve levels of desired floodplain habitat enhancement.</p> <p>Construct and operate a fish ladder and passage system at the Fremont Weir designed to pass adult and juvenile salmon, steelhead, sturgeon, and other fish.</p> <p>Modify Lisbon Weir to improve fish passage.</p> <p>Improve physical habitat in Lower Putah Creek.</p>
<p>16. Improve the genetic integrity and reduce hybridization among Central Valley salmonids</p>	<p>Reduce genetic effects of Nimbus and Trinity Fish Hatchery Operations</p>	<ul style="list-style-type: none"> ■ See Proposed Operations in column 5 ■ OSCM18: Develop and implement hatchery and genetic management plans to minimize the potential for genetic and ecological impacts of hatchery reared salmonids on wild salmonid stocks. [Note: This measures does not include Trinity River hatchery] 	<p>Benefits: Reduce adverse effects of steelhead and fall-run Chinook salmon produced from Nimbus and Trinity hatcheries on wild stocks. Development of an HGMP for Nimbus Fish Hatchery implements part of this RPA action.</p> <p>Expected Outcomes: Maintenance of the genetic integrity and resiliency of wild stocks; reduced effects of hatchery operations on genetic characteristics of the populations.</p> <p>Monitoring: Genetic characteristics of the salmonid populations; evidence of hatchery effects on hybridization.</p> <p>Metrics: Change in genetic characteristics of the population.</p>	<p>N/A (other stressors measures only)</p>

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<p>17. Increase survival of salmonids and other resident and migratory fish within the Delta</p>	<p>Delta flow management to increase survival of salmonids and green sturgeon.</p>	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ HRCMs 4, 6, and 9: Restore 14,000 acres of tidal marsh habitats primarily in Cache Slough, Suisun Marsh, and the west Delta. ▪ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ▪ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ▪ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ▪ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ▪ OSCM16: Reduce illegal harvest of Chinook salmon, Central Valley steelhead, green sturgeon, and white sturgeon in the Delta. ▪ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. ▪ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. ▪ OSCM25: Improve the survival of outmigrating juvenile salmonids by using non-physical barriers to re-direct them away from channels in which survival is lower. 	<p>Benefits: Maintain adequate flows in both the Sacramento and San Joaquin river basins to increase survival of steelhead emigrating to the estuary from the San Joaquin River, and of winter-run and spring-run Chinook salmon, steelhead, and green sturgeon emigrating from the Sacramento River through the Delta to Chipps Island.</p> <p>Conservation measures complement the intent of the objective by increasing survival of outmigrating anadromous fish by reducing effects of toxics on fish and food supply, predation, and Project and non-Project entrainment, and increasing rearing habitat area.</p> <p>Expected Outcomes: Improved growth, survival, and outmigration success of juveniles.</p> <p>Monitoring: Change in juvenile migration pathways, migration rates, and survival; change in indices of juvenile abundance, changes in adult abundance</p> <p>Metrics: Juvenile abundance indices, juvenile salmonid survival and migration, adult abundance, change in habitat quality and availability.</p>	<p>Export operations in accordance with OMR criteria described in Row 3.</p>
<p>18. Improve survival of covered fish</p>	<p>Reduce likelihood of entrainment or salvage at facilities when large numbers of juveniles are migrating through the upper Delta</p>	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ HRCMs 4, 6, and 9: Restore 14,000 acres of tidal marsh habitats primarily in Cache Slough, Suisun Marsh, and the west Delta. ▪ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ▪ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ▪ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ▪ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ▪ OSCM16: Reduce illegal harvest of Chinook salmon, Central Valley steelhead, green sturgeon, and white sturgeon in the Delta. ▪ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. ▪ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. 	<p>Objective: Reduce losses of winter-run and spring-run Chinook salmon, steelhead, and green sturgeon by reducing exports when large numbers of juvenile Chinook salmon are migrating into the upper Delta region, risk of entrainment into the central and south Delta and then to the export pumps.</p> <p>BDCP Benefits: Conservation measures complement the intent of the objective by increasing survival of outmigrating anadromous fish by reducing effects of toxics on fish and food supply, predation, and Project and non-project entrainment, and increasing rearing habitat area.</p> <p>Expected Outcomes: improved growth, survival, and outmigration success of juveniles</p> <p>Monitoring: Change in juvenile salvage and survival; change in indices of abundance</p> <p>Metrics: juvenile abundance indices, juvenile salmonid survival; fish salvage.</p>	<p>Export operations in accordance with OMR criteria described in Row 3.</p>

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19. Improve survival of salvaged fish	Modification of operations and infrastructure of CVP/SWP fish collection facilities	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ OSCM4: Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources that are believed to be toxic to covered fish species and the food organisms upon which they depend. ▪ OSCM5: Reduce the loads of toxic contaminants in stormwater and urban runoff by working with existing efforts in the Delta. ▪ OSCM13: Remove non-native submerged and floating aquatic vegetation from Delta waterways. ▪ OSCM14: Increase the harvest of non-native predatory fish to decrease their abundance. ▪ OSCM16: Reduce illegal harvest of Chinook salmon, Central Valley steelhead, green sturgeon, and white sturgeon in the Delta. ▪ OSCM21: Screen, remove, relocate, consolidate, modify and/or alter timing of non-project diversions to reduce entrainment of covered fish species in the Delta. ▪ OSCM24: Reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations. ▪ Improve fish collection, handling, transport, and release of fish salvage at the SWP and CVP export facilities 	<p>Benefits: Objective: Achieve 75% performance goal for whole facility salvage at both state and federal facilities and improve salvage survival. Conservation measures complement the intent of the objective by increasing the survival of released salvaged fish by reducing effects of toxics on fish and food supply, predation, and Project and non-project entrainment area.</p> <p>Expected Outcomes: Improved growth, survival, and outmigration success of juveniles</p> <p>Monitoring: Change in juvenile migration pathways, migration rates, and survival; change in indices of juvenile abundance; changes in adult abundance</p> <p>Metrics: Juvenile abundance indices, juvenile salmonid survival and migration, adult abundance, change in habitat quality and availability.</p>	<p>Export Operations Preferential export operations from the CVP Jones facility to reduce pre-screen predation losses within Clifton Court Forebay. Consider operating Clifton Court Forebay radial gates in the open position from December 1 to June 30. Improve fish salvage operations and release locations. These export operations would apply only when OMR restrictions are controlling.</p>
20. Reduce risk of mortality associated with physical barriers	Do not implement SDIP Phase I to replace temporary operable gates with permanent operable gates	<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ OSCM25: Improve the survival of outmigrating juvenile salmonids by using non-physical barriers to re-direct them away from channels in which survival is lower (including installing a behavioral barrier at the Head of Old River) 	<p>Benefits: Avoid adverse modification to critical habitat. Non-physical behavioral barrier at the Head of Old River would not affect critical habitat, and could reduce salmonid mortality by reducing exposure to entrainment.</p>	Install temporary agricultural barriers that would not be closed prior to May 15.
21. Improve certainty to both fishery and water delivery interests		<ul style="list-style-type: none"> ▪ See Proposed Operations in column 5 ▪ Implement no net loss strategy and fish account to provide certainty to water management as described in Row 2 		* The operational criteria can be adjusted based on real time monitoring up or down by the Fishery Agencies provided there is no net water supply costs from this regulatory baseline by the time of low-point in San Luis Reservoir (typically late August or early September) unless prior agreement is obtained from SWP and CVP related to carryover debt or credits.
22. Strengthen linkages between science and water operations		BDCP Monitoring and Research Program - strengthen monitoring and implement predictive modeling		None