

Appendix 2B

**Attachment 2: Adaptive Management
Actions and Programs**

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2B-2.1 Timeframe of Implementation and Evaluation of Individual Adaptive Management Actions

1. **Bin 1: Evaluation occurs annually–biannually by technical teams.**

Actions for which agencies evaluate recent data to determine how to proceed before the action is conducted again. Refinement of the approach is expected to occur regularly based on prior data and targeted research. There is an expectation that Bin 1 Adaptive Management Actions or Programs (AMAs) have defined objectives and performance metrics with associated monitoring occurring during the action. Consultation and incidental take permit (ITP) amendment inquiries will be conducted, but reinitiation of consultation or an ITP amendment is not expected to be required to refine the approach to implementation after each evaluation.

Bin 1 AMAs will require components of a structured decision-making (SDM) process to maintain an organized approach for agency collaboration and to ensure transparency in determinations. However, Bin 1 AMAs will be managed adaptively based on present conditions, such as hydrology or annual species status, and will require quick decision-making relative to full SDM. It is not anticipated that Bin 1 AMAs will require long-term action objectives or performance measures to be determined prior to implementation nor will they require identification or evaluation of long-term alternatives. Decision support tools such as utilization of an independent facilitator and Adaptive Management Technical Team (AMT) evaluation of near-term implementation alternatives and tradeoffs will guide the Adaptive Management Steering Committee (AMSC) annual or biannual action decision.

2. **Bin 2: Evaluation and potential refinement occurs within the timeframe of the Biological Opinions and ITP.**

Actions for which agencies evaluate data from multiple years of implementation. There is an expectation that coordinated science and monitoring is occurring during these actions. The evaluation may trigger re-initiation of consultation or an ITP amendment for the actions, or not, depending on scope and scale of recommended change.

Bin 2 will apply to those AMAs that are iterated or linked over time whereby actions taken early on may result in learning that improves management within the next three to eight years. It is anticipated that Bin 2 AMAs have existing AMTs and/or have some understanding of action objectives and performance measures and have already undergone some evaluation of alternatives and tradeoffs. However, it is acknowledged that Bin 2 AMAs may need refinement once implementation has occurred to minimize uncertainties associated with known data gaps. Independent facilitators and AMTs will use decision support tools to assess monitoring data obtained, evaluate updated knowledge base against action objectives and performance measures, develop and evaluate new alternatives if warranted, and present action implementation tradeoffs to the AMSC for consideration.

3. **Bin 3: Evaluation and potential refinement occurs in a longer timeframe on the order of 10–15 years and may inform the next Section 7 consultation and development of a new ITP.**

Actions for which agencies evaluate data over longer periods of implementation, on the order of 10–15 years. There is no expectation of an ongoing evaluation to occur during the time period of the ITP or Biological Opinions (BiOps) for long-term operations of the State Water Project (SWP) and Central Valley Project (CVP). However, there is an expectation that science and monitoring is occurring during the timeframe of the ITP and BiOps to support evaluation and refinement during the development of a new ITP and BiOps.

Bin 3 AMAs may have complex objectives, unknown alternatives, significant uncertainty in outcomes, and or large data gaps. These AMAs require a full SDM process whereby qualified and independent facilitators will guide the AMSC and associated AMTs and utilize decision-analytic tools or SDM process to define relevant uncertainty, develop action alternatives, estimate expected consequences of the alternatives, and evaluate tradeoffs and preferences when making choices between alternative courses of action. It is anticipated that Bin 3 AMAs will require substantial time to plan, evaluate, and implement to facilitate learning opportunities for future action management.

Some AMAs may have components that fall in different bins. For example, some AMAs in Bins 1 and 2 may yield the development of a decision support tool for use in an AMA in Bin 3 during future consultation. Therefore, it is important all AMAs use components of SDM and apply a consistent and coordinated approach to monitoring performance metrics identified so that results from various AMAs can be comprehensively evaluated when related.

2B-2.2 Adaptive Management Actions

1. Winter-run Old and Middle River Flows Management

- a. *Brief Description:* Onramping and offramping Old and Middle River (OMR) flows management for winter-run Chinook Salmon is currently informed by the Salmon Monitoring Team (SaMT). The SaMT is a technical advisory team made up of technical staff from the U.S. Bureau of Reclamation (Reclamation), the California Department of Water Resources (DWR), the National Marine Fisheries Service (NMFS), the California Department of Fish and Wildlife (CDFW), and the State Water Resources Control Board (State Water Board) that synthesizes recent field monitoring data and historical long-term monitoring data, along with expert opinion to ~~provide recommendations for onramping and offramping OMR management to~~ inform the Water Operation Management Team (WOMT). Specifically, the SaMT ~~produces two weekly risk assessments (one authored by Reclamation and one authored by CDFW) that include~~ will evaluate real-time data, including the Salmonid Distribution Table, and the weekly loss threshold table, which classifies the winter-run Chinook Salmon population as the percent in upstream of the Sacramento-San Joaquin Delta (Delta), ~~the percent in the Delta, and the percent downstream of the Delta~~. This information is used to ~~determine whether to onramp or offramp OMR management~~ implement the winter-run weekly loss thresholds and to minimize the effects of water operations on winter-run Chinook Salmon.

Sections 3.3.2.1 and 3.3.2.3 in the ITP Application describe the use of winter-run Chinook Salmon weekly and annual loss thresholds to trigger actions aimed to minimize entrainment and loss of juvenile out-migrants. However, it is anticipated that the criteria associated with the Winter-Run Chinook Salmon Machine Learning Model will need to be reassessed using the genetics-based run-identification loss dataset currently available (Section 3.3.2.1) and a larger effort to develop a real-time assessment tool for the SaMT to recommend OMR management actions to minimize entrainment into the south Delta well before salvage events occur.

b. *Assigned Adaptive Management Bin: Bin 2*

- 1) The development of a model explicitly predicting daily winter-run Chinook Salmon migration timing using historical long-term monitoring data and environmental variables is necessary to ~~reduce the uncertainty of~~ reduce uncertainty in the weekly Salmonid Distribution Table and the estimated percent of winter-run present in the Delta. This model needs to be made readily available as a transparent prediction tool that leverages recent biotic and abiotic data to predict current and near-future migration timing and provided to the SaMT to inform their ~~weekly risk assessments to the Water Operation Management Team~~ discussions prior to reporting to WOMT. This effort should be completed and implemented no later than 2026.
 - 2) The explicit rate of winter-run Chinook Salmon juvenile out-migrant entrainment into the South Delta, the fate of individuals entrained due to OMR management, and the effects of the SWP and CVP south Delta water operations is a topic area in OMR management that has been studied in the past and merits further investigation. Loss associated with salvage events at the SWP and CVP facilities is currently used to trigger OMR management actions, but these detections in salvage occur days or even weeks after individuals were initially entrained into the south Delta and account for only a portion of entrained individuals lost to the population. A new modeling framework is necessary for more effective real-time OMR management actions to be used to minimize winter-run Chinook Salmon entrainment in the south Delta. Specifically, the modeling framework should integrate a winter-run Chinook Salmon distribution model (e.g., Bin 2 item *i* above) with particle tracking model outcomes (potentially the individual-based ECO-PTM model developed by the U.S. Geological Survey and DWR) to estimate the proportion of the out-migrant population vulnerable to entrainment into the south Delta per day, the probability of entrainment into the south Delta given current hydrologic conditions, and the travel time to the water export facilities. Such a modeling framework should be converted into a real-time assessment tool for the SaMT to recommend OMR management actions to minimize entrainment into the south Delta well before salvage events occur.
- c. *Adaptive Management Technical Team:* The existing Winter-run Chinook Machine Learning Interagency Team will lead analysis and development of all winter-run Chinook salmon OMR management sub-actions in coordination with other interested agencies and ~~stakeholders~~ interested parties. Specific work pertaining to this action should be conducted by the current Winter-run Chinook Machine Learning Interagency Team. The team has welcomed input from a diverse array of agency and ~~stakeholder~~ interested party representatives since its inception to provide critical guidance throughout model development and interpretation. This role would continue with the addition of SDM processes as needed.

- d. *Tools:* Winter-Run Chinook Salmon Machine Learning Model

2. Spring-run OMR Management

- a. *Brief description:* Spring-run OMR Management, Science, and Monitoring: The *Spring-run Chinook Salmon and Surrogates* section in Chapter 3 of the ITP Application describes an approach to minimize impacts of SWP and CVP operations in the south Delta on Sacramento-River-origin spring-run Chinook Salmon that relies on detection of hatchery-origin Chinook Salmon (spring-, fall-, and late fall-run) in salvage at the SWP and CVP facilities as surrogates for entrainment of natural-origin spring-run in the central and south Delta. While implementing the Spring-run Hatchery Surrogate measure a parallel effort is ongoing to develop an annual Spring-run Juvenile Production Estimate (JPE) (Section 3.3.15.1). PA Section 3.9.2 describes the timeline for initial program development (interim monitoring, special studies, and development of the JPE database and model) and the intention to utilize independent peer reviews. The Spring-run JPE Core Team is also responsible for evaluating the existing Spring-run Hatchery Surrogate measure. Recommendations from these reviews will inform considerations for future reinitiation of consultation and ITP amendments with NMFS and CDFW. A subsequent independent peer review will be considered to continue to evaluate monitoring and special study data available through the Spring-run JPE as well as the initial Spring-run Lifecycle Model.
- b. *Assigned Adaptive Management Bin:* **Bin 2**

Development of an interim Spring-run JPE is ongoing and independent peer reviews of the Spring-run JPE program will be considered in the near term. Additionally, the Spring-run JPE Core Team is tasked with reviewing the Spring-run Hatchery Surrogate measure (see Section 3.3.15.1) in early 2025.
- c. *Adaptive Management Technical Team:* The Spring-run JPE Core Team is responsible for implementing the Spring-run JPE program, and collaborating with the AMSC to charter independent peer review panels when initiated, and evaluating the Spring-run Hatchery Surrogate measure. After these reviews DWR and Reclamation will continue to convene the Spring-run JPE Core Team and subteams in coordination with CDFW, NMFS, and the U.S. Fish and Wildlife Service (USFWS), and support implementation of the Spring-run JPE Science Plan, the Spring-run JPE Monitoring Plan, the Spring-run JPE Race ID Program Development Plan, the Spring-run JPE Data Management Strategy, and updates to those plans.
- d. *Tools:* The Spring-run JPE and the Spring-run Lifecycle Model are key tools needed to reduce uncertainty regarding the timing and abundance of young-of-year and yearling life stages entering the Delta from the Sacramento River and assess impacts of a variety of stressors on spring-run Chinook Salmon.

3. Larval and Juvenile Delta Smelt OMR Management

- a. *Brief Description:* The Larval and Juvenile Delta Smelt Protection Action in Chapter 3 of the ITP Application describes an approach to minimize the impacts of the SWP and CVP operations in the south Delta on larval and juvenile Delta Smelt that relies on the collection of Secchi depth data by field surveys. While this metric of water clarity is based upon the best available science, it is anticipated that an evaluation of turbidity data from telemetered water quality stations across the south and central Delta could yield a trigger that would be more responsive to real-time conditions and would eliminate the need for field crews to

conduct additional Secchi depth surveys when data is needed more frequently than biweekly. The turbidity-based trigger level will be as close as is feasible to matching the existing Secchi depth trigger of 1 meter, including using multiple turbidity stations to match the geographic scope of the 12 stations used for the Secchi depth trigger.

b. *Assigned Adaptive Management Bin: Bin 2*

Development of a turbidity-based trigger to replace the Secchi depth trigger will be considered in the near term.

c. *Adaptive Management Technical Team:* A team of technical staff from CDFW, USFWS, DWR, and Reclamation will convene to discuss analytical approaches to developing a turbidity-based trigger that provides the same level of minimization as the Secchi depth trigger.

d. *Tools:* The Delta Smelt Life Cycle Model informed the development of the Secchi depth trigger and may be used to evaluate a turbidity-based trigger.

4. **Larval and Juvenile Longfin Smelt OMR Management**

a. *Brief Description:* The Larval and Juvenile Longfin Smelt Protection Action in Chapter 3 of the ITP Application describes an approach to minimize the impacts of the SWP and CVP operations in the south Delta on larval and juvenile Longfin Smelt that relies on paired real-time hydrologic and monitoring triggers. While these OMR management triggers are designed to provide entrainment minimization for larval and juvenile Longfin Smelt, the inclusion of new monitoring data and quantitative tools could provide further evaluation of environmental and monitoring data that could potentially yield an action that would be more responsive to real-time conditions and be more effective at minimizing entrainment.

b. *Assigned Adaptive Management Bin: Bin 2*

Development of a new OMR management trigger will be considered in the near term.

c. *Adaptive Management Technical Team:* A team of technical staff from CDFW, USFWS, DWR, and Reclamation will convene to discuss analytical approaches to analyzing water quality, hydrologic, and distribution data to inform the creation of a new trigger framework initiating OMR management.

d. *Tools:* Available water quality, hydrologic, and fish monitoring datasets will be analyzed, as well as relevant flow and particle tracking models, as appropriate. New Longfin Smelt life cycle model tools will be utilized, as available.

5. **Summer-Fall Habitat Action for Delta Smelt**

To study habitat effects on Delta Smelt survival and evaluate effectiveness of mitigation actions in improving habitat and food availability, DWR and Reclamation have proposed the Summer-Fall Habitat Action (SFHA). The SFHA includes, but is not limited, to the actions described below. The Delta Coordination Group (DCG) will (1) develop a multi-year science and monitoring plan for the SFHA including focused studies and (2) conduct reviews of action plans and seasonal action results to inform future summer-fall actions or improvements to science and monitoring to inform uncertainties in evaluation. DCG will utilize project-specific and technical teams for coordination on the adaptive management framework as described in the Program. Specific adaptive management plans for SFHAs will be reviewed by the AMT (where applicable), and coordination with the AMT may differ for actions based on assignment of adaptive management bins.

6. Fall X2

- a. Brief Description: To increase the amount of low-salinity zone habitat for Delta Smelt in Wet and Above Normal hydrologic year types, DWR and Reclamation will maintain a 30-day average X2 \leq 80 km from September 1 through October 31.

In 2012, USFWS initiated the development of several life cycle modeling efforts to better understand the factors that affect Delta Smelt population growth rates. These efforts led to two published life cycle models. The results of these life cycle model variations support the hypothesis that Delta outflow in the summer has a stronger effect on Delta Smelt survival than Delta outflow in the fall. The best information currently available suggests that high summer flows help align habitat needs of Delta Smelt in the Suisun Marsh and Suisun Bay region, including turbidity and water temperature, while also increasing food subsidies, supporting Delta Smelt growth and survival. - The same outcome is expected if flows are high enough in the fall, but the response of Delta Smelt is expected to be less, because ambient air temperatures cool into more appropriate ranges and the prey subsidy is reduced as prey populations seasonally senesce. These changes in fall habitat conditions are expected to occur part - way through the September–November time period considered in the Delta Smelt life cycle models. This newer information merits a robust synthesis effort to bring together available modeling tools, including the Delta Smelt life cycle model, and monitoring data.

- b. Assigned AM Bin: Bin 1

While science and monitoring in the summer and fall will occur each year (during implementation and non-implementation years), evaluation of the Fall X2 action will occur on a shorter timeframe, after multiple years of implementation since its inception in 2008. The AMT will work with described technical teams to develop a comprehensive synthesis of summer-fall habitat conditions to inform the development of an adaptive management plan. The AMT may recommend an independent workshop or review of the Fall X2 action following sufficient a robust evaluation and synthesis effort. The AMSC may also request that the AMT develop alternative X2 actions to implement during the summer-fall time period that provide equal or better benefits to Delta Smelt as the Fall X2 action originally developed in 2008.

Adaptive Management Technical Team: The DCG, in collaboration with DCG technical teams (Science and Monitoring Workgroup and Hydrology and Operations Workgroup) will be responsible for developing adaptive management plans specific to the Fall X2 including describing adaptive management objectives, hypotheses, and performance metrics for evaluation.

- a c. *Suisun Marsh Salinity Control Gate*

- 1) *Brief Description: To improve Delta Smelt habitat in Suisun Marsh and Grizzly Bay during summer-fall, the Suisun Marsh Salinity Control Gates (SMSCG) will be operated as described in Section 3.3.4 to maximize the number of days at Belden's Landing where the three-day average of salinity is equal or less than 4 practical salinity units (psu) during Above Normal and Below Normal years and 6 psu in Dry years with the goal of maximizing the amount of suitable habitat available to Delta Smelt in Suisun Marsh and Grizzly Bay.*

2) *Assigned Adaptive Management Bin: Bin 3*

While science and monitoring will occur each year (during implementation and non-implementation years), evaluation of SMSCG operation efficacy will occur on a longer timeframe after multiple years of implementation across a range of hydrologic conditions, within 10–15 years. The AMT will work with described technical teams to review monitoring plans and focused research as needed within the larger SDM process. They may recommend an independent workshop or review of the action following sufficient implementation and monitoring for a robust evaluation.

- 3) *Adaptive Management Technical Team:* DCG, in collaboration with DCG technical teams (Science and Monitoring Workgroup and Hydrology and Operations Workgroup) will be responsible for developing adaptive management plans specific to the SMSCG action including describing objectives, hypotheses, and performance metrics for evaluation.

b d. *Experimental Food Enhancement Actions*

- 1) *Brief Description:* Each year food subsidy measures to augment the SFHA will be considered. Food actions may include a number of implementation alternatives (e.g., water source, timing, intensity) that have been evaluated by the DCG to inform future plans. Food subsidy actions are hypothesized to increase localized prey availability for Delta Smelt in the north Delta and Suisun Marsh, resulting in opportunities for higher growth and survival of juvenile and sub-adult life stages. Food actions include North Delta Food Subsidy Action, Managed Wetland reoperation in Suisun Marsh, and Sacramento Deepwater Ship Channel Food Subsidy Action.

2) *Assigned Adaptive Management Bin: Bin 2*

Following multiple years of implementation, data collection, and results, DCG may suggest convening an independent workshop or review panel within the timeframe of the consultation and ITP. Results will be included in seasonal reporting and adaptive management reviews to evaluate the science and monitoring, efficacy of actions, hypothetical alternative strategies and/or actions, and potential inclusion of food subsidy actions as potential permanent action elements of the SFHA, or if appropriate, termination of actions deemed ineffective by the AMSC.

- 3) *Adaptive Management Technical Team:* Food subsidy action plans, monitoring plans, focused research and reports will be developed by DCG, in collaboration with DCG technical teams (Science and Monitoring Workgroup and Hydrology and Operations Workgroup). Together, teams will be responsible for developing adaptive management plans specific to food actions including describing objectives, hypotheses, performance metrics for evaluation, and timeline.

6 z. **Tidal Habitat Restoration Effectiveness for Smelt Fishes**

- a. *Brief Description:* DWR and Reclamation propose to carry forward habitat restoration acre targets identified from the 2008 and 2019 USFWS BiOps (8,000 acres) and the 2020 ITP (396.3 acres) to complete mitigation requirements for Delta Smelt and Longfin Smelt (per the 2020 ITP). DWR and Reclamation propose to meet the total acreage requirement (8,396.3 acres) through completion of habitat restoration projects. The projects identified in the PA are in different phases of completion: (1) constructed (3,584 acres), (2) in construction (3,490 acres), or (3) planned (1,662 acres). All identified restoration projects

are located in the northern arc of the upper estuary and are designed to enhance food production and rearing habitat for Delta Smelt and Longfin Smelt (per the 2020 ITP). DWR and Reclamation will complete its 8,396.3-acre restoration requirements by 2026.

b. *Assigned Adaptive Management Bin: Bins 1 and 3*

Bin 1: Some actions involving treatment or clearing of invasive vegetation, use or presence of livestock, or other land management actions will be evaluated on an annual or biannual basis. These evaluations may inform revisions to site-specific Long-term Management Plans, which are required of DWR and Reclamation as part of the mitigation.

Bin 3: To understand the effectiveness of tidal wetland restoration for providing a food subsidy for pelagic areas to benefit Delta Smelt as well as juvenile rearing habitat for Chinook Salmon, monitoring occurring as part of the DWR-CDFW Fish Restoration Program will continue throughout the permitted period. Monitoring will allow assessment of the biotic and abiotic capacity of restored tidal wetlands to support listed fish species, the opportunity for fish to access wetland-derived resources, and actual use of those resources. Reference wetlands will continue to be monitored concurrently to account for dynamic regional conditions that also affect restored habitats. Following multiple years of monitoring and targeted studies to address specific uncertainties regarding effectiveness of tidal wetland restoration, such as the ability of restoration locations to provide food resources to Delta Smelt at critical times of the year, observations of Delta Smelt or juvenile Chinook Salmon occupying restoration sites or utilizing restored resources, and retrospective evaluation of the tidal marsh restoration site quality and or effectiveness relative to targets identified, the AMSC will provide guidance to the AMT in prioritizing data and information for synthesis work. Syntheses for understanding efficacy of tidal wetland restoration may regard food subsidy, effects of restoration on water quality, prevalence of invasive aquatic vegetation, utilization of restored habitat by Delta Smelt and listed salmonids, as well as evaluations of site design and local geomorphology on tidal wetland function as a food web subsidy. Based on the data resources and information available, the AMT may recommend that an independent workshop or peer review panel be convened to assist with evaluation and collecting lessons learned. Information gathered through syntheses, workshops, and/or independent review panels will be used to inform future tidal wetland restoration designs and future reinitiation of consultation for the SWP and CVP with USFWS and NMFS and ITP amendments for the SWP with CDFW.

c. *Adaptive Management Technical Teams:*

- 1) DWR and CDFW will lead evaluations of land management actions to inform and develop changes to site specific Long-term Management Plans based on information gained through evaluation of specific management practices and will coordinate accordingly with Reclamation, USFWS, and NMFS on plan revisions.
- 2) An interagency technical team composed of scientists from DWR, Reclamation, CDFW, USFWS, and state and federal water contracting entities, as well as any consultants contracted for focused research on specific uncertainties regarding tidal wetland restoration will be responsible for data analyses and synthesis work. This team will work with the AMSC to prioritize data analyses that are responsive to specific hypotheses regarding tidal wetland restoration effectiveness as a food subsidy and juvenile salmon rearing habitat. At milestones for analysis and reporting of special studies or multi-year syntheses, the inter-agency technical team will present its findings

to the Interagency Ecological Program's Tidal Wetland Project Work Team, which is an open and collaborative venue for exchange of scientific ideas and information.

7.8. **Tributary Habitat Restoration Effectiveness for Salmonid Fishes**

- a. *Brief Description:* The Upper Sacramento River Anadromous Fish Habitat Restoration Project Monitoring Plan and Protocols (2017) are designed to determine the effectiveness of the Upper Sacramento River Anadromous Fish Habitat Restoration Project in meeting identified objectives and to validate the linkage between restoration actions and the biologic response to those actions. This monitoring plan follows the framework for detecting biological responses to flow management described by Souchon et al. (2008). Monitoring methods structured as field protocols are described in the Plan and Protocols, including control site selection, longitudinal profile and cross sections, juvenile habitat mapping protocols, snorkel survey protocols, seining, enclosure studies, invertebrate drift sampling, redd surveys, and stream temperatures.
- b. *Assigned Adaptive Management Bins: Bins 1 and 3*

Bin 1: Some actions involving annual land management practices will be evaluated on an annual or biannual basis. These evaluations may inform revisions to site-specific Long-term Management Plans, which are required of DWR and Reclamation as part of the mitigation.

Bin 3: Monitoring and targeted studies to address specific uncertainties regarding effectiveness of tributary habitat restoration inform the Science Integration Team's (SIT's) decision support models. The AMT will review recommendations from decision support models to assess critical uncertainties to understand the effectiveness of tributary habitat restoration in providing spawning and refuge habitat to benefit Chinook Salmon, monitoring occurring as part of the Anadromous Fish Habitat Restoration Program throughout the permitted period.
- c. *Adaptive Management Technical Team:* The existing Central Valley Project Improvement Act (CVPIA) Upper Sacramento River Habitat Restoration Technical Team includes Reclamation, USFWS, NMFS, CDFW, consultants (e.g., Chico State University, Pacific States Marine Fisheries Commission), and recipients of competitive funding for habitat restoration will be utilized as the AMT for this action.

8.9. **Shasta Spring Pulse Studies**

- a. *Brief Description:* Reclamation will release up to 150 thousand acre-feet (TAF) in pulse flow(s) each water year to benefit Chinook Salmon in the Sacramento River watershed. In 2021, a multi-year Upper Sacramento River Spring Pulse Flow Study Plan was developed by Reclamation in coordination with CDFW, USFWS, NMFS, State Water Board, UC Santa Cruz, and the Sacramento River Settlement Contractors. The timing, magnitude, duration, and frequency of the pulse flows will be evaluated and refined by the Sacramento River Group (SRG) on an annual basis and with the intent of maximizing multi-species benefits, which may include coordinating timing of pulse flows with natural flow events and/or pulse flows in tributaries. The pulse flow schedule will be planned by the agencies and ~~stakeholders~~ interested parties in the SRG and implemented annually by Reclamation. Reclamation will reduce the volume of a pulse flow, not release a pulse flow, or apply the water to another purpose only if CDFW, NMFS, or USFWS determines that these alternatives will be more beneficial to fish species. CDFW or NMFS would consider reducing the volume of a pulse flow or not releasing a pulse flow if, for example:

- 1) The releases would increase the forecasted winter-run Chinook Salmon mean annual temperature-dependent mortality by 10% or more, or
 - 2) The 150 TAF pulse flow volume (regardless of when it is released) would decrease the forecasted end of April Shasta storage to below 2.2 million acre-feet using the February 90% exceedance forecast.
- b. *Assigned Adaptive Management Bin: Bins 2 and 3*
- Bin 2:** Hindcast evaluation of action effectiveness that includes technical review of the functional elements of the pulse flow (i.e., timing, magnitude, duration, and frequency) as well as an evaluation of criteria used to support beneficial use decisions.
- Bin 3:** If Bin 2 evaluations indicate a set of triggers and or the timing and magnitude of spring pulse flows are beyond what was considered in the Proposed Action or review of conditions, triggers, and effects after multiple years of implementation across a range of hydrologic conditions determines there is new understanding and/or information that is significantly different from what was applied to the effects analysis at the time of ESA consultation initiation. Reviews will also provide an opportunity to consider refined understanding and potential applications to other tributaries, divisions, or systems.
- c. *Adaptive Management Technical Team:*
- Bin 2 responsibilities would be assigned to the SRG.
- Bin 3 responsibilities would be assigned to the SRG, Shasta Operations Team (SHOT), and the AMSC.

9 10. Winter-run Chinook Salmon Through-Delta Survival and Salvage Thresholds

- a. *Brief Description:* There is considerable uncertainty surrounding the implications of facility loss of juvenile Sacramento River winter-run Chinook Salmon at CVP and SWP facilities for through-Delta survival in the Delta. Juvenile salmon through-Delta survival, as measured at Chipps Island (Delta exit), accounts for route-specific survival and migration routing through different migratory pathways. Field and modeling studies will address these uncertainties by conducting the following analyses: (1) an acoustic receiver network and associated real-time modeling of the data, (2) targeted acoustic telemetry studies (i.e., tag fish and release them in the Delta, (3) retrospective analyses of data to evaluate through-Delta survival due to LTO operations, (4) incorporation and consideration of any additional routing and survival data obtained, (5) evaluation of the sensitivity of winter-run Chinook Salmon population dynamics, relative to recovery and viability criteria, to through-Delta survival using lifecycle modeling, and (6) analyses of the relationship between loss at facilities and broader Delta conditions using a combination of particle tracking models. Several lifecycle models, including simplified simulation-based approaches, the CVPIA SIT DSM, and the National Marine Fisheries Service Southwest Science Center (SWFSC) Winter-run Chinook Salmon Lifecycle Model, may be considered to evaluate winter-run Chinook Salmon population responses to varying Delta conditions and identify a target Delta survival. We propose using multiple particle tracking models (e.g., PTM, ECO-PTM, ePTM), with competing tradeoffs related to ease of implementation and assumptions about particle movement and mortality, to assess relationships between loss at facilities and Delta survival.

b. *Assigned Adaptive Management Bin: Bin 2*

Studies will be completed to address uncertainties in the estimation of through-Delta survival. These newly generated modeling results will be used to propose and update decision support tools for juvenile Chinook Salmon related to outmigration survival and entrainment risk and may change the triggers for export reductions. This work may be of interest to independent review panels. New information and its application may inform future reinitiation of consultation and ITP amendments.

- c. *Adaptive Management Technical Team:* This work has been of interest to SIT, which has identified these studies as critical for reducing uncertainty in entrainment risk management. Field coordination and implementation of these studies has occurred through the Interagency Telemetry Advisory Group (ITAG) since 2018. Technical review may occur through the SIT and/or ITAG.

~~10~~ **11. Longfin Smelt Science Plan Actions**

- a. *Brief Description:* Section 3.3.15 of the ITP Application describes the continued implementation of the Longfin Smelt Science Program and updating its science plan. The science plan is a roadmap for addressing substantial gaps in our understanding of the biology and ecology of Longfin Smelt, which include management activities needed to prevent further decline of the species within the San Francisco Estuary. To accomplish this, the Longfin Smelt Technical Team (LFSTT) will continue to develop and support the ongoing activities of the Longfin Smelt Science Program. These activities will address one or more of the seven priority areas of the science plan and are expected to produce valuable information for resource managers. These priority areas are: (1) continued development of the Longfin Smelt lifecycle model, (2) providing input and guidance for the Longfin Smelt culture program, (3) improved distribution monitoring, (4) improved larval entrainment monitoring, (5) improved understanding of spawning and rearing habitat, (6) understanding migration and movement behaviors, and (7) factors that affect abundance, growth, and survival. Findings from the scientific activities conducted within the program will inform considerations for future consultations and ITPs. However, if new information pertinent to real-time operations for Longfin Smelt entrainment or if LFSTT provides other information relevant to management actions for Longfin Smelt during the term of the BiOp or ITP, trigger re-initiation of consultation or an ITP amendment for the actions.

b. *Assigned Adaptive Management Bin: Bin 2*

A Longfin Smelt Science Plan has been developed and implementation of high-priority individual science actions has begun. Actions already underway include development of a Longfin Smelt lifecycle model, establishing Longfin Smelt in culture, and improved distribution monitoring. The LFSTT has prioritized science actions to allow for sequenced implementation and completion over the course of the next eight years. As a result, actions will be ready for evaluation and be available to inform development of a subsequent permit/consultation.

- c. *Adaptive Management Technical Team:* The LFSTT would be assigned all responsibilities for guiding implementation of each Longfin Smelt Science Action identified in the Longfin Smelt Science Plan. The LFSTT is co-lead by DWR and CDFW and includes representatives from USFWS, Reclamation, and the state/federal water contractors.

~~11~~ 12. Delta Smelt Supplementation

- a. *Brief Description:* DWR and Reclamation propose to support continued experimental releases and the development of a program to conduct supplementation of the wild Delta Smelt population with propagated fish consistent with USFWS' Supplementation Strategy (U.S. Fish and Wildlife Service 2020). Reclamation and DWR will ensure production ramps up to a minimum of 125,000 fish by water year 2024, a minimum of 150,000 fish by water year 2025, and a minimum of 200,000 fish by water year 2026 that are at least 200 days post-hatch or equivalent as informed by CDFW and USFWS. USFWS and CDFW, in coordination with Reclamation and DWR, will update the Supplementation Strategy to incorporate new findings from the program and update performance metrics used to guide production targets and methods development.

- b. *Assigned Adaptive Management Bin: Bins 1 and 2*

Bin 1: A process to evaluate production targets to support supplementation will be developed and implemented no less than annually via the existing Culture and Supplementation of Smelt (CASS) Steering Committee. Outcomes of the review may include but are not limited to revisions of production numbers, timeline, release methods, monitoring, and genetic management strategies. These findings will be incorporated into the Supplementation Strategy and will serve as guidance for the program.

Bin 2: Additionally, an independent peer review of the program may be conducted on a five-year basis at the discretion of the AMSC.

- c. *Adaptive Management Technical Team:* The CASS group was created in 2019 and is comprised of participants from Reclamation, DWR, CDFW, and USFWS. This body provides oversight in advancing science-based management activities to secure and stabilize the Delta Smelt population through a coordinated propagation and supplementation program. The CASS Steering Committee shall continue to provide guidance to its three working groups: (1) Captive Propagation Working Group, (2) Research Working Group, and (3) Regulatory Working Group. The CASS Steering Committee may be integrated into the AMSC following formation of the AMSC.

~~12~~ 13. Steelhead JPE

- a. *Brief description:* Reclamation proposes to develop a steelhead JPE for tributaries with CVP facilities that will focus on the annual production of outmigrating juvenile steelhead. Data used in the JPE will inform the status and trends of Sacramento and San Joaquin basin steelhead and may also help inform actions that will increase steelhead abundance and improve steelhead survival through the Delta.

- b. *Assigned Adaptive Management Bin: Bin 2*

Reclamation and DWR propose to conduct the first four-year independent panel review (2024) from data generated from the Stanislaus River steelhead lifecycle monitoring program. Beginning fall 2025 and based upon incorporated 2024 review panel feedback and recommendations, Reclamation and DWR will work with the technical team to consider an expanded JPE framework to the San Joaquin and Sacramento basins. By summer 2026, Reclamation and DWR will decide to address deficiencies in the JPE framework and/or expand the JPE framework to remaining CVP or SWP tributaries. Reclamation and DWR

propose to conduct the second four-year independent panel review (2028) from data generated from the San Joaquin and Sacramento basins JPE.

- c. *Adaptive Management Technical Team:* Reclamation and DWR, in coordination with USFWS, NMFS, CDFW, and interested stakeholders parties, will create or use an existing technical team should one be later identified to develop the steelhead JPE framework and incorporate feedback from the 2024 and 2028 panel reviews.

~~13~~ 14. **Alternative Salmonid Loss Estimation Pilot Study**

- a. *Brief description:* DWR, in coordination with Reclamation, has completed a draft updated Alternative Loss Equation (ALE-22) software tool for estimating winter-run and spring-run Chinook Salmon and Central Valley steelhead losses at the SWP and CVP export facilities. DWR, in coordination with Reclamation and the Alternative Loss Equation Technical Team (ALE-TT), a proposed new sub-team of the Central Valley Fish Facilities Review Team, will further refine the parameters of this tool by developing an Alternative Loss Pilot Study Implementation Plan (ALPS-IP) to implement this tool in parallel with current loss estimation methods and incorporate SDM to prioritize loss component studies and performance evaluation studies. The goal of this pilot study is to provide a more accurate estimates of salmonid loss, and loss parameters, at the SWP and CVP export facilities while understanding the utility of the new alternative method relative to the existing method.

- b. *Assigned Adaptive Management Bin:* **Bin 2**

Within the first year of the effective date of the Record of Decision (ROD) or ITP, DWR, in collaboration with Reclamation, will convene the ALE-TT and conduct a knowledge transfer and methods workshop for the ALE-22 tool and prepare a draft ALPS-IP for ALE-TT review. Within the second year of the effective date of the ROD or ITP, DWR will submit the final draft ALPS-IP for both the ALE-TT and AMSC review. DWR will finalize the ALPS-IP once approved by the AMSC and establish priorities (e.g., loss parameter studies) using SDM within the ALE-TT. The ALE-TT may utilize an independent science panel review to further enhance the SDM prioritization process. In the third year of the effective date of the ROD or ITP, DWR will submit prioritized ALPS-IP recommendations, informed by the ALE-TT SDM process, to the AMSC for approval. The permittee shall then update the loss equation with refinement to the loss equation components as approved by CDFW.

- c. *Adaptive Management Technical Team:*

- 1) Knowledge transfer and methods workshop: DWR and Reclamation will convene the ALE-TT, with membership comprised of DWR, Reclamation, CDFW, USFWS, NMFS, and state/federal water contractors representatives, as well as other interested stakeholders parties.
- 2) Review of the initial draft ALPS-IP: ALE-TT
- 3) Review of the final draft ALPS-IP: ALE-TT, AMSC, as well as input from the Central Valley Fish Facilities Review Team and SaMT
- 4) SDM Prioritization of ALPS-IP: ALE-TT, with support from an independent review panel if requested.

~~14~~ 15. **Shasta Coldwater Pool Management**

- a. *Brief Description:* Reclamation will operate Shasta Reservoir to build a coldwater pool and use the temperature control device on Shasta Dam to blend water from different reservoir strata to protect downstream winter-run Chinook Salmon returning adults and incubating eggs from temperature stressors. An annual operation of the Shasta temperature control device and the development of the temperature management plan will be developed as part of real-time operations. Shasta Reservoir coldwater pool management will rely on an objectives-based management framework adapted from the multi-year drought sequence experienced in Victoria, Australia (Mount et al. 2016) that considers the available hydrology to “Protect,” “Maintain,” “Recover,” and “Enhance,” protected species, habitats, and water deliveries. An initial set of objectives and metrics will be further refined according to increased understanding of species needs, interannual hydrologic conditions (e.g., drought) and operational limitations.
- b. *Assigned Adaptive Management Bin:* **Bin 2**
Hindcast evaluation of action effectiveness that includes a review of the objectives and metrics used to guide annual temperature planning. Objective-based storage targets and temperature dependent mortality will be considered with regard to their ability to support species viability and water delivery performance.
- c. *Adaptive Management Technical Team:* Evaluation of action effectiveness and objective-based criteria would be assigned to the SRG.

~~15~~ 16. **Georgiana Slough Salmonid Migratory Barrier Effectiveness for Salmonid Fishes**

- a. *Brief Description:* DWR, in coordination with Reclamation, will continue to seasonally install and operate a salmonid migratory barrier at Georgiana Slough each year to reduce entrainment into the central and south Delta of emigrating juvenile salmonids. Operation of the salmonid migratory barrier should improve the seasonally averaged through-Delta survival probability to Chipps Island compared with survival probability if the salmonid barrier were not in operation. Barrier operations and monitoring details are defined in the Georgiana Slough Salmonid Migratory Barrier (GSSMB) Operations and Monitoring Plans developed by the GSSMB Coordination Group. To further maximize seasonal survival benefits to migrating salmonids, DWR and Reclamation will continue leading the GSSMB Coordination Group, with membership comprised of DWR, Reclamation, CDFW, USFWS, NMFS, and state/federal water contractors representatives. DWR and Reclamation, working with the GSSMB Coordination Group, will provide at least a triennial report and review and update, as necessary, the GSSMB Operations and Monitoring Plans.
- b. *Assigned Adaptive Management Bin:* **Bin 2**
Triennial report of GSSMB operations and monitoring that can be used to inform necessary changes/updates to the Operations and Monitoring Plans.
- c. *Adaptive Management Technical Team:* Triennial report and updating the GSSMB Operations and Management Plan would be assigned to the GSSMB Coordination Group.

~~16~~ 17. **Spring Outflow**

- a. *Brief Description:* Reclamation and DWR will supplement Delta outflow during spring months per the terms of the Voluntary Agreements (VAs) as described in the March 2022 VA Term Sheet, revised in November 2022. Actions that will support the additional Delta

outflow include Reclamation and DWR south-of-Delta export modifications, Reclamation reoperating upstream reservoirs to advance and allow for scheduling of water made available by contractors in CVP watersheds, and passing Delta inflow from water made available by VA Parties. In the latter case, spring flow pulses on VA tributary systems (Sacramento, American, Feather, Mokelumne, Yuba, and Tuolumne rivers and Putah Creek) are intended to benefit juvenile Chinook Salmon growth and survival in the tributaries while also contributing to increased Delta outflows. The increased Delta outflows are intended to benefit Chinook Salmon outmigration survival in the Delta and enhance habitat for native estuarine fishes, including Delta Smelt and Longfin Smelt. The amount of supplemental Delta outflows will vary by water year type, with 750–825 TAF provided in Dry, Below Normal, and Above Normal years, and approximately 150 TAF provided in Critical and Wet years. The supplemental flows will occur during the months of March through May and prioritized during the period of April 1–May 31. The details of flow amounts by source and water year type are provided in Section 3.3.3 of the ITP Application and in the November 2022 revision of the March 2022 VA Term Sheet. Supplemental spring Delta outflows are proposed as part of a path of implementation for an updated State Water Board Bay-Delta Water Quality Control Plan. In advance of the State Water Board’s decision regarding the VA proposal, the supplemental Delta outflows will occur as an early implementation action and continue if and when the State Water Board incorporates the VA actions into an updated Water Quality Control Plan. During implementation, supplemental spring flows will be managed by real-time operation groups to determine the source, schedule, and amount of water to ensure consistency with proposed flow levels as described in the VA Term Sheet.

b. *Assigned Adaptive Management Bin: **Bin 3***

Spring Outflow is assigned to Bin 3 to allow for a synthetic, multi-year evaluation of the performance of increased spring Delta outflows to inform the next reinitiation of consultation for long-term operations of the SWP and CVP and development of a California Endangered Species Act ITP.

c. *Adaptive Management Technical Team: The Voluntary Agreement Science Committee (VASC)* is facilitated by an independent third party and is comprised of scientists and science managers from DWR, Reclamation, CDFW, NMFS, USFWS, and the public water agency organizations of the VA Parties, with staff from the State Water Board participating in an advisory capacity. The VA Term Sheet includes provisions for a VA Science Program to support adaptive management of VA actions, including increased spring flows on tributaries and Delta outflow. The VASC intends to use quantitative decision-support tools (e.g., lifecycle models for Chinook Salmon) and SDM processes to provide recommendations to the VA Program’s decision-making body, the Systemwide Governance Committee. To support the VA program’s adaptive management process, the VASC has developed a draft VA Science Plan, which contains hypotheses, metrics, and baselines for evaluating increased spring Delta outflows and pulse flows on tributaries. The draft VA Science Plan thus provides a framework for a multi-year evaluation of whether supplemental spring flows are performing according to expectations and will inform the State Water Board evaluation of the VA Program in Years 6–8 of the program, including how and whether the VA Program should continue after Year 8. The VASC will support adaptive management of spring outflows for the BiOp by providing the multi-year, synthetic evaluation developed for the VA Program to the AMSC to inform future major reinitiation of consultation and ITP amendments.

17 18. Clear Creek

- a. *Brief Description:* A draft proposal from Reclamation for long-term Clear Creek/Whiskeytown Reservoir operations includes a novel approach to exerting desirable intra-annual flow variability. A draft new flow regime would implement variable flows over the course of a year that would range from flow releases as low as 100 cubic feet per second (cfs) in late summer, adapting flow needs during spring-run Chinook Salmon spawning/the onset of fall-run spawning in September/October, and (ultimately) slowly ramping up to 300 cfs in the winter when fry could benefit from seasonally inundated surfaces, then ramping back down to 100 cfs the following summer to start again. This flow variability will create a more natural seasonally variable hydrograph and is expected to provide opportunity for gravel augmentation or other restoration to target surface elevations and channel form for seasonal inundation to benefit salmon rearing. There are expected benefits and potential consequences from these changes. Continuation of existing, and some proposed, monitoring efforts including but not limited to Red Bluff US Fish and Wildlife Service Office (RBFWO)-maintained temperature loggers, potential spawning area mapping, spawn area mapping, rotary screw trapping, spawning surveys, snorkel surveys, video weir, redd mapping, and proposed habitat monitoring will be important for evaluation of these management actions.
- b. *Assigned Adaptive Management Bin:* **Bin 2**

An adaptive management and monitoring approach to the new flow regime and/or temperature criteria will be useful for determining if the flow variability indeed provides viable opportunity to contribute to restoring channel form and floodplain elevations to targeting rearing habitat and improved growth and survival for juvenile salmon, and for guiding adjustments to flow and temperature criteria if necessary. It is anticipated that adaptive management refinements would occur at approximately three-year intervals, although more frequent refinements may be necessary in the first few years of the new flow regime.
- c. *Adaptive Management Technical Team:* Field coordination and implementation of monitoring studies would occur through the existing Clear Creek Technical Team (CCTT). The CCTT, with representatives from Reclamation, USFWS, NMFS, DWR, CDFW, and others, provides Central Valley Operations with an annual pulse flow and temperature management proposal. This proposal details the CCTT's request for pulse flow releases from Whiskeytown Dam (e.g., flow schedule, ramping rates, peak flow) and water temperature management, as well as background information on fish monitoring and proposal rationale. It is anticipated that the CCTT will continue to provide annual proposals and that they will include details on how best to implement the variable flow regime and meet water temperature criteria. Additionally, the CCTT is anticipated to review outcomes of the flow regime and make suggestions to improve future management actions for the benefit of fish and wildlife on Clear Creek. Additionally, the CCTT provides Reclamation with an annual summary of management activities on Clear Creek. These reports highlight the past water year's conditions, management actions and results, habitat restoration projects, fisheries monitoring data, and the CCTT's meeting discussions. It is anticipated that these annual summaries will continue to provide evaluations and potential refinements for future year's flow and temperature management.

2B-2.3 References Cited

Sauchon Y, Sabaton C, Deibel R, Reiser D, Kershner J, Gard M, Katapodis C, Leonard P, Poff NL, Miller WJ, and Lamb BL. 2008. "Detecting Biological Responses to Flow Management: Missed Opportunities; Future Directions." *River Research and Applications* 24:506–518.