Adaptive Management Implementation Framework for the Reinitiation of Consultation of the Long-term Operation of the Central Valley Project and State Water Project

DRAFT, November 20, 2018

1 Introduction

This Adaptive Management Implementation Framework (AMIF) is intended to assist the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) in utilizing the best available science currently available to operate the Central Valley Project (CVP) and the State Water Project (SWP) in a manner that will provide improved conditions for federally protected fish species.

In 2008, Reclamation and DWR reinitiated Section 7 consultation under the Endangered Species Act on the CVP and SWP operations and received Biological Opinions (BOs) from both the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) for federally listed fishes. Both BOs provided jeopardy decisions on the species under each agency jurisdiction. Reclamation and DWR have reinitated consultation on the long-term operation of the CVP and SWP (ROC on LTO) to incorporate formal decision support frameworks and new science, while considering effects from habitat loss, harvest, invasive species, contaminants, hatcheries, and other stressors can better manage our scarce water resources.

1.1 Central Valley Project

The CVP was constructed by the Reclamation for the purpose of river regulation, navigation improvement, flood control, water storage, water distribution, and power. Later regulations (e.g., Central Valley Project Improvement Act, or CVPIA) specified the CVP must also be used for fish and wildlife enhancement. The CVP is composed of more than 18 reservoirs with a combined storage capacity of more than 11 million acre-feet, more than 10 hydroelectric power plants, and more than 500 miles of major canals and aqueducts. These facilities are generally operated as an integrated project, although they are authorized and categorized in more distinct units or divisions.

1.2 State Water Project

To provide a more reliable water supply and reduce the flood risk in the Sacramento Valley, the California legislature appropriated funds to the DWR to construct the SWP. The SWP includes the Oroville Facilities on the Feather River, a Delta cross channel, an electric power transmission system, 2 aqueducts, and several southern California reservoirs. DWR is required to plan for recreational and fish and wildlife uses of water in connection with the uses of water in connection with the SWP and other state-constructed water projects.

1.3 Existing CVP and SWP Efforts for Fish

CVPIA, signed into law in 1992, mandates changes in management of the CVP for the protection, restoration, and enhancement of fish and wildlife, including the provision of 800,000 acre-feet of water dedicated to fish and wildlife annually; water transfers provisions; special efforts to restore anadromous fish populations by 2002, restoration fund financed by water and power users for habitat restoration and enhancement and water and land acquisitions; installation of the temperature control devise at Shasta Dam; and development of a plan to increase CVP yield.

Some of the beneficial actions through the CVP and CVPIA include (CVPIA Annual report 2014):

- RPA implementation
    - Restore floodplain habitat, including at Yolo Bypass
    - Upgrade Red Bluff Diversion Dam and operate to prevent the delays of fish migration
    - Reservoir operations to manage the cold water pool for the needs of the listed fish species and minimize flow fluctuation effects
- Improved spawning and rearing habitat
- Knights Landing outfall gates improvements (voluntary water user action)
- Updated operation of the Head of Old River Barrier
- Clear Creek Restoration Program
- Instream Water Acquisition Program
- Implementation of short pulse flows
- Shasta Temperature Control Device
- Improvements at the Tracy Pumping Plant
- Improved fish passage and screening
- Increased monitoring programs
- Delta lands purchased for tidal habitat restoration projects

2 Intent of Adaptive Management Implementation Framework

Based on the Reclamation Adaptive Management Technical Guide (Williams et al. 2007), adaptive management is defined as:

> *Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.*

Similarly, the California Water Code definition is:

> *Adaptive management is defined in Delta Reform Act (Water Code §85052) as "a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management*

planning and implementation of a project to achieve specified objectives." An adaptive management approach provides a structured process that allows for taking action under uncertain conditions based on the best available science, closely monitoring and evaluating outcomes, and re-evaluating and adjusting decisions as more information is learned.

An important similarity in both definitions is that adaptive management is based on a flexible decision-making process. For the ROC on LTO, the framework for adaptive management includes a structured decision-making process that incorporates uncertainty by recognizing there are different possible outcomes to management actions. This provides information that allows flexibility in operational decisions and other management actions that can be adjusted as needed based on the fisheries responses, whether immediate or over time, and as the outcomes become better understood.

The ROC on LTO AMIF provides a process to make informed decisions and better decisions, that create more benefits for less water supply impacts. Reclamation may take different adaptive management actions – identified in the ROC on LTO Biological Assessment and Environmental Impact Statement as well as below. In exchange for these actions, increased operational flexibility would be granted/earned in accordance with the biological objective met by the action. Structured Decision Making (SDM), a quantitative method of adaptive management, can help identify the highest priority actions to undertake, and thus provide an investment strategy.

The AMIF will support strong collaborative, voluntary partnerships, use decision science-based models to aid in determining the appropriate actions to implement, and determine if an intervention action is triggered. It will also identify research, monitoring, and evaluation actions required to fill in any data gaps. Finally, it will provide a formalized process for transparency and accountability through adaptive management, scientific review, issue resolution, and reporting.

The intent of the AMIF is to: (VERIFY we show these in this document)

- Put water operations in the broader context of fisheries management
    - Recognize other stressors such as hatcheries, harvest, and non-flow measures
- Maximize water supply by improving science around the necessary protection for listed fish species
- Integrate water and fish management to avoid species jeopardy
- Build a process to identify areas of scientific uncertainty to prioritize studies
- Build a process that can identify the most cost-effective (dollars versus water) actions or strategies to take for fish.
- Describe how meeting the biological objectives through non-flow measures can increase operational flexibility
- Perform monitoring and modeling refinements to update science

3 Conceptual Framework

3.1 Structured Decision-Making Team

The goal for the long-term operations is to establish a collaborative process between Reclamation and DWR with resource agencies, water users, power contractors/agencies, non-governmental organizations (NGOs), and other stakeholder or interested parties. This collaboration is to support future

implementation and operational decisions within the range of accepted criteria. Figure 1 shows the organization chart for the structured decision-making team.

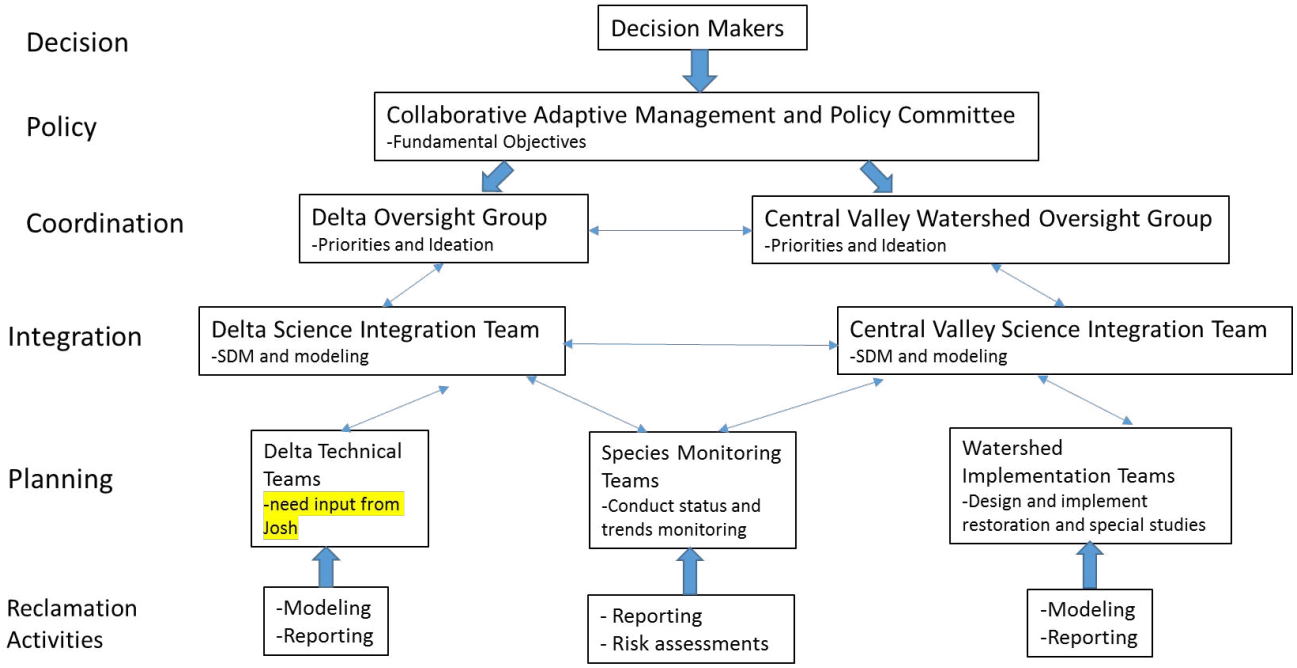

Figure 1. Organization Chart for the Structured Decision-Making Team

3.1.1 Decision Makers

Decision makers are the regional agency directors that have legal authority and the ability to commit funding. Each agency/organization retains its current decision-making apparatus, and pledges to consider the outcomes of the SDM process in its future decisions. The Decision Makers' role will be to make the final decision on recommendations, policies, and changes posed by the groups described below.

3.1.2 Collaborative Adaptive Management and Policy Committee

The Collaborative Adaptive Management and Policy Committee includes managers from fish and water management agencies (Reclamation, NMFS, DWR, USFWS, and California Department of Fish and Wildlife [CDFW]), State Water Resources Control Board) and public organizations (water users, non-governmental organizations (NGOs), power contractors/agencies, and sport and commercial fishing groups). The Committee is an intermediary between the decision makers and the Regional Oversight Coordination Groups (described below). This Committee, co-led by Reclamation and DWR, commit to working through the collaborative process to discuss and interpret non-flow and other intervention management actions to the extent possible and to elevate any disputes to appropriate levels of officials for each group.

This Committee is responsible for setting the fundamental objectives. The Science Mentor (described below) will interact with the Committee and will be led by the Adaptive Management Facilitator (see below).

3.1.3 Adaptive Management Facilitator

The Adaptive Management Facilitator is a neutral party that will work with the Collaborative Adaptive Management and Policy Committee, the Regional Oversight Coordination Groups, and the Science Integration Teams.

The responsibility of the Adaptive Management Facilitator is to:

- Manage schedules
- Provide meeting minutes
- Track action items
- Ensure clear communication
- Diffuse any conflict

3.1.4 Regional Oversight Coordination Groups

The two Regional Oversight Coordination Teams – Central Valley Watershed Oversight Group and Delta Oversight Group – would be responsible for developing scenarios, review SDM prioritization, and constructing action suites to achieve the fundamental objectives for fish and water management affected by the CVP and SWP. Because of the quantity of effort required to undertake these efforts, these two regional oversight groups will work independently and coordinate quarterly as a combined BO Implementation Management Team. Together these two teams will provide the coordination for review, integration, and implementation of action suites.

This committee is responsible for setting the fundamental objectives. The Science Mentor will interact with the Regional Oversight Coordination Groups and will be led by the Adaptive Management Facilitator.

3.1.4.1 Central Valley Watershed Oversight Group

The current CVPIA Core Team will become the Central Valley Watershed Oversight Group. The Central Valley Watershed Oversight Group would lead the strategy, ideation, and overall prioritization to define the fundamental objectives for fish in the Central Valley river watersheds. This group will be led by Reclamation and guided by the Science Mentor and Modeling Mentor(see below).

3.1.4.2 Delta Oversight Group

The Delta Coordination Group will consist of the existing Interagency Implementation and Coordination Group (IICG) established through the California WaterFix program, and the Interagency Ecological Program (IEP) Coordination Team. These two groups would combine to lead the strategy, ideation, and overall prioritization to get to the fundamental objectives for fish in the Delta. Like the Central Valley Watershed Oversight Group, the Delta Oversight Group will be led by Reclamation and guided by the Science Mentor and Modeling Mentor (see below).

3.1.5 Science Mentor

The Science Mentor is a nationally recognized expert in SDM and/or Adaptive Management, and will lead the SDM process with the Integration Teams, helping set the overall SDM strategy, establish milestones and schedules, and define products. The Science Mentor coordinates the production of conceptual and explicit models, and products of those models.

3.1.6 Modeling Mentor

The Modeling Mentor leads the development of the Decision Support Model (DSM) with the input from the Science Integration Teams and the Science Mentor.

3.1.7 Science Integration Teams

The two Science Integration Teams – Central Valley Science Integration Team and Delta Science Integration Team – are responsible for synthesizing the science and providing a list of priority actions to benefit fish species to the Oversight Groups.

3.1.7.1 Central Valley Science Integration Team

The current CVPIA Science Integration Team will become the Central Valley Science Integration Team, along with new members as appropriate, and would update the existing DSMs established by the CVPIA Science Integration Team. The Central Valley Science Integration Team will be responsible for executing the SDM process and presenting the evaluation of scenarios developed by the Central Valley Watershed Oversight Group. The team consists of experts (science and technical staff) from agencies, NGOs, stakeholder groups, and other interested parties throughout the Central Valley. The Central Valley team will be directed by the Science Mentor and a Modeling Mentor employed by Reclamation. They will develop conceptual and system models to analyze relevant factors that impact water reliability and fishery production within the tributaries and rivers in the Central Valley. Opportunities may exist for individual tributary groups to develop discrete models for partnerships working within CVP and SWP watersheds (see below). These tributary groups may coalesce and manage science produced by the Monitoring Team and Watershed Groups and submits the results to the Central Valley Watershed Oversight Group. The Watershed Implementation and Monitoring teams will receive guidance, milestones, and schedules, from the Central Valley Science Integration Team.

The Central Valley Science Integration Team will balance the landscape and watershed-specific strategies by applying program expertise across watersheds and retaining watershed-specific knowledge and relationships.

Responsibilities include:

- Updating conceptual models
- Updating and maintaining monitoring inventory
- Updating the Decision Support Models (DSM)
- Guiding and producing synthesizing-science for the Central Valley
- Producing annual reports/technical memos documenting the state of the DSMs, and any recommendations

3.1.7.2 Delta Science Integration Team

The Delta Science Program SDM Team, along with new members as appropriate, will become the Delta Science Integration Team, which executes the SDM process and presents the evaluation of scenarios developed by the Delta Oversight Group. The Delta team consists of experts (science and technical staff) from agencies, stakeholder groups, and other interested parties in the Delta. The team is directed by the Science Mentor and a Modeling Mentor employed by Reclamation. The team develops conceptual and system models to analyze relevant factors that impact water reliability and fishery production within the Delta, Suisun Marsh, and Yolo Bypass. This team may coalesce and manage science produced by the Monitoring Team and Delta Technical Team and submit the results to the Delta Oversight Group.

Responsibilities include:

- Updating conceptual models
- Updating and maintaining monitoring inventory
- Updating the Decision Support Models (DSM)
- Guiding and producing synthesizing-science for the Delta
- Producing annual reports/technical memos documenting the state of the DSMs, and any recommendations

3.1.8 Watershed Implementation Teams

A team of experts may be established for each tributary (Sacramento, Feather, American, Stanislaus, and others as necessary) to design and implement restoration and special studies to achieve fundamental objectives and reduce uncertainty. The team consists of experts (science and technical staff) from agencies, stakeholder groups, and other interested parties throughout their watershed.

These groups would replace the existing Sacramento River Temperature Task Group, Clear Creek Technical Working Group, American River Group, Stanislaus Operations Group, and other watershed or tributary specific groups.

3.1.9 Species Monitoring Teams

There are existing monitoring teams that target specific species. These teams will continue to work towards providing species-specific data, as well as refine or add new monitoring programs as needed and as determined through the DSM results from the Science Integration Teams. NEED MORE

3.1.10 Delta Technical Teams

The Delta Science Team will consist of Delta fisheries experts for both salmonids, sturgeon and smelt, to focus on key flow, habitat, diversion, and other operational issues. This group would replace the existing Smelt Working Group, DOSS, and the Delta Fish and Water Management Team.

Responsible for synthesizing science for the Delta

3.2 Relationship of Adaptive Management to Real-Time Operations

Under the ROC on LTO, Reclamation and DWR's goal is to flexibly operate the CVP within a set of established boundaries, rather than operate to fixed and potentially conflicting requirements, thus requiring agencies to prioritize one or more species over others. Applying an adaptive management approach would allow Reclamation and DWR to implement a suite of seasonal actions (including operational) as part of the annual water and fish management cycle that will best protect the listed fish species.

Reclamation and DWR would maintain control over real-time operations of the CVP and SWP. The Central Valley and Delta Science Integration Teams will provide Reclamation and DWR information on the effects of the action suites, as well as the fish distribution and abundance to inform Reclamation and DWR's decision making process. Reclamation and DWR would operate within criteria established by the ROC on LTO Proposed Action.

Results of real-time operations are subject to adaptive management through the SDM process which could end up modifying the action in the future. Adaptive management and the SDM processes do not apply to real-time operations when they are made on a daily, weekly or monthly time scale, because uncertainty reduction (e.g., research or monitoring) cannot be developed and deployed in that same window of time. However, changes to operational criteria under the ROC on LTO may be changed over time through the adaptive management process based on new information as part of the annual review.

3.3 Structured Decision-Making Framework

Structured Decision Making is a process from the field of decision sciences that breaks down complex decisions into different components. These components consist of explicit quantifiable objectives, decision alternatives (i.e., management actions), and models that are used to predict changes in the objectives due to each management action or set of actions. The SDM process provides a transparent decision-making framework that incorporates and evaluates the influence of uncertainty on decision making. When a decision involves multiple objectives, the model predictions and estimates of uncertainty are used to evaluate tradeoffs and identify key uncertainties for further study or reduction through an adaptive management process.

The SDM process is a quantitative form of adaptive management. In adaptive management, a problem is first defined, which leads to defined fundamental and means objectives. Once these are all defined, conceptual and quantitative models are developed to evaluate actions or scenarios and identify priorities for management actions. These actions are then tested through implementation and monitoring, the outcome of which are compared to the modeled predictions. If there is a difference between the outcome and the model prediction, then the models are improved, and actions are modified accordingly. Figure 1 shows the basic steps in an adaptive management process. ROD TO PROVIDE NEW FIGURE

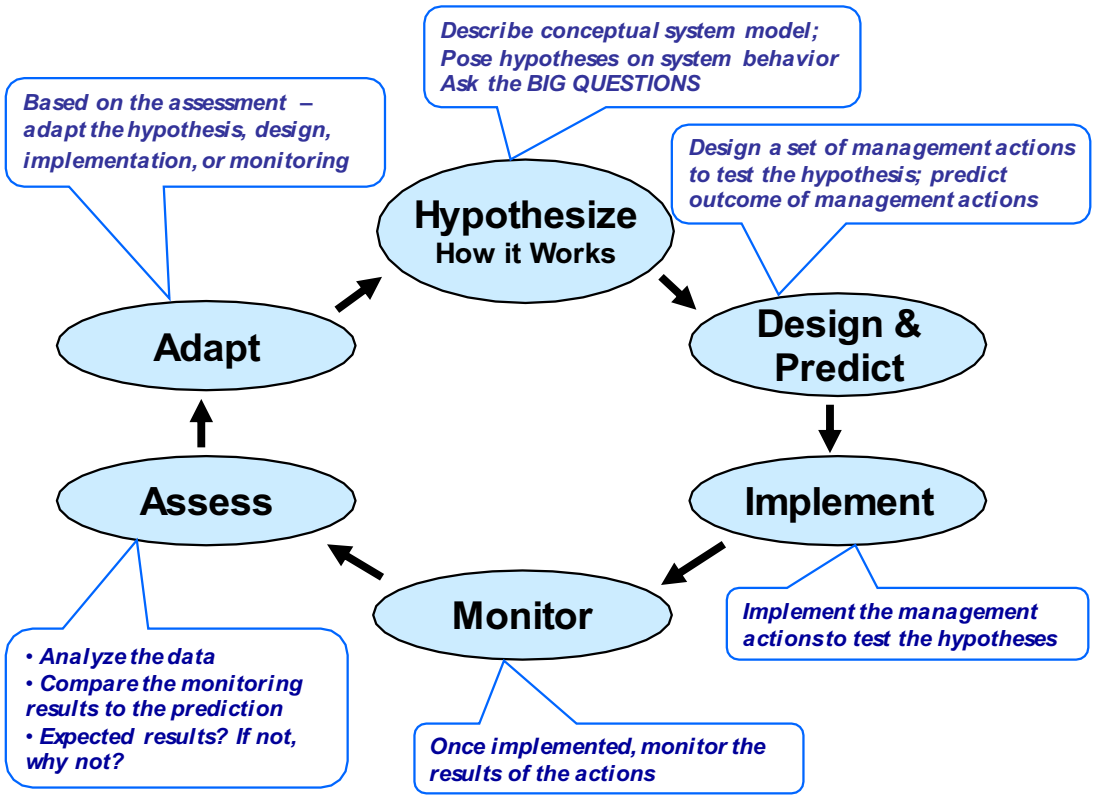

Figure 2. Adaptive Management Diagram

3.3.1 Fundamental Objectives and Means Objectives

Fundamental objectives are objectives that are the most important and relate directly to the core values to decision makers and stakeholders (Conroy and Peterson 2013). Means objectives are actions that can be taken that help achieve or realize fundamental objectives. Fundamental objectives are generally non-negotiable and must be agreed upon before the proceeding with development of the SDM framework.

Fundamental Objectives are what the Decision Makers want to accomplish. These are the most highly valued attributes or products of the system and are often derived from the mission of each participant. Reclamation and DWR have determined the initial fundamental and means objectives, as described below, for the ROC on LTO. These objectives may be revised by the Central Valley and Delta Science Integration Teams, as appropriate. Examples of fundamental objectives for Reclamation and DWR could include:

- Maximize water supplies, and some water supply to carry through drought
- Non-jeopardy level of juveniles at Chipps Island and minimum population to carry through drought

Means Objectives are the steps or processes that achieve the Fundamental Objectives. Examples of means objectives to meet the fundamental objective for a non-jeopardy level of juveniles at Chipps could include:

- Increased Abundance
- Increased Productivity
- Increased Diversity

It is important to determine the fundamental and means objectives early in the adaptive management process, particularly when there are multiple stakeholders involved. Clearly defining these objectives are vital in the communication between the Collaborative Adaptive Management and Policy Committee and the Oversight and Science teams, as well as those groups responsible for monitoring and data gathering. Clearly defined objectives are important in the development of the models, both conceptual and quantitative, as well as in the establishment of monitoring and research programs that provide useable and valuable data.

3.3.2 Conceptual Model

Conceptual models are a vital component in SDM processes. They link decision alternatives to the objectives and provide the means to predict the effects of management actions and identify the optimal or most suitable decision.

The Central Valley and Delta Science Integration Teams will use conceptual models developed by the CVPIA Science Integration Team; Delta Fish and Water Management Team; Management, Analysis, and Synthesis Team (MAST), and Salmon and Sturgeon Assessment of Indicators by Life Stage (SAIL) synthesis teams as their initial conceptual models. These conceptual models have gone through years of consensus building to develop. The Integration Teams will update the conceptual models as appropriate and document any updates.

3.3.3 Decision Support Model

The ROC on LTO Adaptive Management Program will use the existing DSMs such as the CVPIA Science Integration Team, Delta Science Program SDM, and other ongoing SDM processes. The Central Valley

and Delta Science Integration Teams may update the quantitative models as appropriate over time, in accordance with changes in the conceptual models or more monitoring to improve the quantitative model's depiction of the conceptual linkages. Reconceptualization can take place in a structured and transparent process, as much as necessary to ensure buy-in from all new participants while retaining buy-in from the originators. These models are currently based on observed or empirical data, synthesized data, and expert elicitation.

3.3.4 Action Suites

Actions that would be implemented to protect listed fish species would be chosen from the three Action Suites, described below, based on the environmental conditions and the results from the DSMs which indicate have the most benefit for the least money or water cost.

Where there are significant new circumstances or significant new information relating to the Action Suites or their impacts, supplementation of the National Environmental Protection Act (NEPA) documents (e.g., EIS, EA) is necessary. The requirement to supplement applies so long as there is a meaningful opportunity for the deciding (Federal lead???) agency to weigh the prospective benefits of the proposal against its environmental impacts. Supplementation follows the same procedure and employs the same standards applicable to the original documents. Investigation, however, may show that new information (impacts??) is not significant. Judicial review of such a determination by an agency is limited to an "arbitrary and capricious" standard. Reclamation and DWR will consider supplementation when adaptations to the proposed Action Suites vary from the original in the following manners:

- Spatial extents exceed the initial extents to the degree that the analyses of impacts cannot be extrapolated or are no longer applicable. For example, if habitat restoration was extended from one mile of the mainstem Sacramento River to one and one-half miles, and the features in the extended area are mostly homogenous with the features in the original area, and the rates of habitat creation are comparable, then the impacts could reasonably be extrapolated. If, however, the fluvial morphology in the extended area changed significantly, then the biological impacts could probably not be extrapolate, and analyses should be supplemented.
- Time frame for one or more of the actions within a suite change significantly, producing impacts that are outside of the time frames of the original analysis. For example, an Action Suite includes a pulse flow for prompting emigration of juvenile salmonids, and the pulse flow is scheduled to coincide with the majority of the juveniles present reaching a fork length of 70 millimeter. The timing of the peak of the pulse flow is dependent upon the growth rates of juvenile fish in the reach. Analysis would bracket the most likely time frame for the bulk of the juveniles to cross the growth threshold. As long as the pulse flow occurs within that time bracket, no supplemental analysis is required.
- Significant changes to, additions, or subtractions of actions within an Action Suite. (purposefully vaguely defined)

To maximize water deliveries, Reclamation would implement programs that pair additional flexibility for water operations with construction of habitat and facility improvements that address the status of listed species (non-flow projects). Additional flexibility for water operations would include less restriction on storing, releasing, and/or diverting water.

These actions are described programmatically in the ROC on LTO environmental compliance documents. Subsequent project-specific compliance and consultation would be needed for implementation. In the subsequent project-specific compliance and consultation, each habitat restoration or non-flow action would be paired with an action to increase operational flexibility, such as increasing the salvage threshold, relaxing temperature compliance, or otherwise reducing the amount of water needed for flows for fish. Actions that would be implemented to protect listed fish species would be chosen from the actions described below based on the environmental conditions and the results from the DSMs produced by the Central Valley and Delta Science Integration Teams which indicate have the most benefit for the least money or water cost.

Over time, Reclamation would consult on one or more project-specific designs and the corresponding increase in operational flexibility that requires an Incidental Take Statement. If the water supply benefits warrant the costs, Reclamation would construct the project. Upon completion of construction, Reclamation would implement the additional water supply flexibility and monitor performance.

The benefits of implementing a project would occur at the same time as the construction is completed. Adaptive management of the programs would monitor the effectiveness and refine the decision support models to improve the assessments of water supply benefits on subsequent consultations. If the performance of the non-flow project differs substantially from the expectations developed under the models, the standard triggers for reinitiation would apply.

Reclamation and DWR propose to replace water operations teams with watershed monitoring teams with, at minimum, an opportunity for a representative from each federal and state agency, that provide information on the real-time distribution of species and life-stage transitions. Reclamation would perform a risk analysis for the operation of the CVP and SWP and would confer with NMFS and USFWS, if Reclamation determines technical assistance is warranted. Annual reporting will demonstrate compliance with the ESA. Modifications to the proposed action would follow the reinitiation triggers under the ESA.

3.3.4.1 Maintain Actions

Maintain Actions are implemented in non-drought water years, and are met primarily through flow actions, such as water operations and criteria. Maintain Actions include:

- Release and Temperature Schedules
- Power Bypasses and Limitations on Peaking Operations
- Routing of Flows
- Delta Hydrodynamic Requirements
- Outflow Requirements
- Carryover Storage Targets
- Banking and Transfer Programs

Examples of outcomes of the Maintain Actions could include:

- Suitable water temperatures for holding and spawning
- Suitable water temperatures for most redds
- Avoid redd dewatering
- Improved migration flows

As described above, Maintain Actions could be reduced as restore actions (i.e., adaptive management non-flow actions) are successfully implemented*. In drought years,* Maintain Actions *would likely not be implemented as they are typically not deemed feasible to meet*. Instead, Reclamation would implement a protect action that offsets the impact of not meeting the Maintain Action by meeting the biological objective in a different way (see below).

3.3.4.2 Protect Actions

Protect Actions are implemented during periods of extreme stress, when adverse conditions are predicted, to avoid or mitigate the situation conditions of high mortality to listed fish. Protective actions are largely focused on addressing drought conditions when flow-based actions would impose a high water cost and impair water supply and fish and wildlife project purposes in non-drought years. A contingency process would be established to avoid or mitigate situation conditions of high mortality to listed fish. These could include early warning indicators; significant decline indicators; species-specific contingency plans; or an observed substantial mortality event.

Rapid response actions would be implemented promptly and could include:

- Trap and haul of wild or conservation hatchery fish
- Increased production of conservation hatchery fish

Long-term contingency actions (more than 1 year to implement) will avoid mortality could include:

- Creation, Expansion, and Use of Conservation Hatcheries for steelhead, delta smelt, winter-run Chinook salmon, spring-run Chinook salmon
- Trap and haul programs for wild and/or conservation hatchery fish (adults and juveniles)
- Predator management programs
- Fish collection facilities
- Fish passage past CVP facilities

Protect Actions that handle fish though conservation hatcheries, trap and haul, and rescue programs would further reduce the risk of extinction and allow for maximizing water deliveries and marketable power while addressing the status of listed species.

3.3.4.3 Restore Actions

Restore Actions promote the production of sufficient numbers of juveniles per adult to enable the rebuilding of fish populations. Restore Actions are intended to increase productivity through non-flow habitat and facility improvement measures when funding is available, and only if chosen by Reclamation and/or DWR, or other funding entities. Restore Actions would be watershed-based adaptive management actions that would implement additional habitat and facility improvements on a voluntary basis. Completion of voluntary improvements would create additional operational flexibility by reducing restrictions on water operations for listed species.

Restore Actions for could include: (NOTE, should we identify which items will require separate NEPA and ESA consultation?*)

Sacramento River

- Spawning and Rearing Habitat: Pursuant to CVPIA 3406(b)(13) Reclamation proposes to protect and restore natural channel and riparian habitat values through habitat restoration actions. The

creation of spawning and rearing habitat mitigates for the indirect effects on habitat downstream of Shasta Dam due to water operations. Reclamation proposes to create approximately 110 acres of suitable spawning and rearing habitat over 22 projects in the Upper Sacramento by 2030.

  - Reclamation may implement up to 350 acres of spawning habitat. The CVPIA Science Integration Team models show that this acreage would increase the inundated area of suitable gravel substrate for spawning habitat from supporting 21,000 adult returns to supporting 114,000 adult returns. Reclamation may partner with local water users, NGOs, RCDs, and others to accomplish this task.*
  - Reclamation may implement up to 750 acres of rearing habitat for salmonids. The CVPIA SIT models show that these acreages would increase the inundated area of suitable depths and velocities for spawning habitat from supporting 3.7 million fry to 310 million salmon fry.*

- Shasta TCD Modifications: Reclamation may implement construction actions to fix or reduce leakage in the current Shasta Temperature Control Device. The ability to manage cold water for absorbing additional BTUs of heating in the summer would be accounted for in the Summer and end of September Temperature Management planning.*
- Lower Intakes near Wilkins Slough: Reclamation may provide grants to water users to enable lowering intakes near Wilkins Slough to allow diversion at lower flows. This would reduce demands on Shasta to maintain river elevations and allow for conserving cold water during drought. The ability to manage cold water for absorbing additional BTUs of heating in the summer would be accounted for in the Summer and end of September Temperature Management planning.*
- Colusa Basin Drain Food Web Routing: Reclamation may work with partners to flush agricultural drainage (i.e. nutrients) from the Colusa Basin Drain through Knight's Landing Ridge Cut and the Tule Canal to Cache Slough, improving the aquatic food web in the North Delta for fish species. Reclamation would work with DWR and partners to augment flow in the Yolo Bypass in June through September by operating Wallace Weir and routing water from Colusa Basin into Yolo Bypass to promote fish food production. Zooplankton produced on the Yolo Bypass would move downstream into the Sacramento River in an area where juvenile and adult delta smelt are known to occur at a time of year when food availability may be a limiting factor.

  Increasing food availability for Delta Smelt may increase the area with other habitat parameters already in place that meets the physical and biological features for Delta Smelt critical habitat. Increasing food availability increases juvenile salmonid growth and survival, and would be accounted for with an increase in allowable salvage in subsequent years, if food is limiting in the year the action is taken. *

  [Critical Habitat physical and biological features for Delta smelt food - tradeoff] - juvenile salmonids growth and survival
- Flooded Rice Fields: Flooding rice fields can increase floodplain habitat, as well as provide increased food reserves, which can be flushed into the Sacramento River to benefit listed salmonids. Increasing the food available in the Sacramento River would increase future years returning adults, if food is limiting.*

- Mill, Deer, and Antelope Tributary Restoration for Spring-Run: The Sacramento River consists of multiple tributaries which could involve restoration projects to aid listed salmonids and native species. Restoration projects that may be considered include; floodplain restoration, the creation of side channel spawning and rearing areas, and the addition of habitat structures and spawning gravel. Additional rearing habitat would increase juvenile outmigrants, increasing adult returns of Spring-run in the Delta, and therefore additional salvage would be allowed at the pumps, if rearing habitat is limiting.

  Reclamation may implement up to 10 acres of spawning habitat in Deer Creek to support 6,500 Spring-Run adult returns, an increase from the current 1,700 amount of Spring-Run adult returns. Reclamation may implement up to 60 acres of spawning habitat to support 4,500,000 Spring-Run fry, an increase from 1,500,000 Spring-Run fry.

  Reclamation may implement up to 7 acres of spawning habitat in Mill Creek to support 4,400 Spring-Run adult returns, an increase from the current 1,800 Spring-Run adult returns. Reclamation may implement up to 66 acres of spawning habitat to support 5,000,000 Spring-Run fry, an increase from 1,600,000 Spring-Run fry.*
- Battle Creek Restoration: Reclamation may accelerate implementation of the Battle Creek Salmon and Steelhead Restoration Project, which is intended reestablish approximately 42 miles of prime salmon and steelhead habitat on Battle Creek, and an additional 6 miles on its tributaries. Winter-run Chinook salmon are currently limited to a single population that spawns in a 5-mile stretch of the Sacramento River, but they are being reintroduced to Battle Creek (around 200,000 juveniles were released in Battle Creek in 2018), and this new population would benefit from the restoration efforts. An additional population of Winter-run Chinook salmon on Battle Creek would provide temperature compliance flexibility.*

Feather River

- Diversion Screening: DWR may screen any remaining small unscreened diversions along the Feather River downstream of the FERC boundary to reduce entrainment of salmonids. This may increase juvenile survival, with a corresponding flexibility at Jones and Banks Pumping Plants for salvage.*
- Passage: DWR may remove the Sunset Pumps rock weir, as described in the Salmon Resiliency Strategy (SRS), to improve adult spring-run Chinook salmon and green sturgeon passage on the Feather River. This could improve passage efficiency during certain flows, and reduce juvenile predation at the structure. This would be expected to increase survival and increase juvenile outmigrants, with a corresponding flexibility at Jones and Banks Pumping Plants for salvage.*
- Rearing Habitat: DWR may create additional floodplain rearing habitat restoration within existing levee setbacks on the Lower Feather River, as described in the Lower Feather River Corridor Management Plan (LFRCMP). This would improve juvenile survival, leading to more juveniles captured at Jones and Banks Pumping Plants and corresponding flexibility in salvage.

  Reclamation may implement up to 260 acres of spawning and rearing habitat to support 150,000 fall-run Chinook salmon adult returns, an increase from 3,000 fall-run Chinook salmon

adult returns. Reclamation may implement up to 215 acres to support 16,000,000 fall-run Chinook salmon fry, an increase from 12,500,000 fall-run Chinook salmon fry.

- Sutter Bypass: DWR may increase connectivity of the Sutter Bypass with the Feather River to increase juvenile salmonid rearing habitat. Increasing inundation of the Sutter Bypass can increase food and floodplain habitat for listed salmonids. Inundating the Sutter Bypass would provide suitable depths and velocities to support rearing habitat for up to XX juvenile fry. This could afford flexibility in salvage corresponding to the expected increase in juveniles upstream.*

American River

- Spawning and Rearing Habitat: The creation of spawning and rearing habitat mitigates for the indirect effects on habitat downstream of Folsom Dam due to water operations. Pursuant to CVPIA 3406(b)(13), Reclamation proposes to implement the Cordova Creek Phase II and Carmichael Creek Restoration projects, and increase woody material in the American River by planting trees. Reclamation also proposes to conduct annual maintenance at: Nimbus main channel and side channel, Upper Sailor Bar, Lower Sailor Bar, Upper Sunrise (RM 21.5), Lower Sunrise, Sacramento Bar, River Bend, Discovery Park Floodplain, Bank Protection Wood, and Sunrise Stranding Reduction
    - Reclamation proposes to conduct restoration projects that include gravel augmentation to better support and create spawning habitat in the American River for 245 acres. This effort would focus on the maximum amount of effort needed to create and restore habitat for listed salmonids. Increased temperature flexibility would result from additional area with appropriate substrate in the cold area. This changes from supporting 74,000 adults to supporting 160,000 adults.
      Reclamation may implement up to 2,600 acres of rearing habitat for salmonids. The CVPIA SIT models show that these acreages would increase the inundated area of suitable depths and velocities for spawning habitat from supporting 525,000 fry to 200 million salmon fry.*
    - Reclamation may conduct rearing habitat projects to improve juvenile growth and survival, including large woody debris placement. Corresponding flexibility would be provided in allowed salvage, if habitat is limiting.*
- Drought Temperature Management: In severe droughts, Reclamation would de-gang the Folsom Dam shutters to allow temperature flexibility.

Stanislaus River

- Spawning and Rearing Habitat: Under the CVPIA (b)(13) program, Reclamation's annual goal of gravel placement is approximately 4,500 tons in the Stanislaus River.
    - By 2024, Reclamation may place approximately 75,000 tons of spawning gravel in the Stanislaus River. After reaching this goal, Reclamation would place approximately 12,000 tons of gravel per year in the Stanislaus River. Reclamation may also create another 34 acres of spawning habitat. This would increase the area of suitable spawning substrate from supporting XX adults to XX adults.
    - Reclamation may create another 171 acres of side channel and floodplain rearing habitat, based on the CVPIA doubling goal for the Stanislaus River of 22,000 in adult

escapement. This would increase the inundated area of suitable depths and velocities for rearing juvenile salmonids from XX to XX.

San Joaquin River

- Lower SJR Spawning and Rearing Habitat (Steady Finance): Reclamation may create a regional partnership to define and implement a large-scale floodplain habitat restoration effort in the Lower San Joaquin River. This stretch of the San Joaquin River is cut-off from its floodplain due to an extensive levee system, with two notable exceptions at Dos Rios Ranch (1,600 acres) and the San Joaquin River National Wildlife Refuge (2,200 acres). In recent years, there has been growing interest in multi-benefit floodplain habitat restoration projects in the Central Valley that can provide increased flood protection for urban and agricultural lands, improved riparian corridors for terrestrial plants and wildlife, and enhanced floodplain habitat for fish. The resulting restoration could include thousands of acres of interconnected (or closely spaced) floodplain areas with coordinated and/or collaborative funding and management. Such a largescale effort along this corridor would require significant support from a variety of stakeholders, which could be facilitated through a regional partnership. Every XX acres of rearing habitat added would support an additional XX salmonid fry, with salvage adjusted accordingly, if habitat is limiting.
- Acceleration of the SJRRP: Reclamation may accelerate rearing habitat restoration under the San Joaquin River Restoration Program. Spring-run are experimental population here… what is the trade-off / credit?

Delta

- Tidal Marsh: Reclamation and DWR propose to continue to restore 8,000 acres of tidal marsh in the Sacramento - San Joaquin Delta, including implementing some EcoRestore projects as identified in the 2008 U.S. Fish and Wildlife Service BO requirements, California EcoRestore goals, and restoration pursuant to California WaterFix Proposed Action, as well as selecting new areas for restoration.
  This action mitigates indirect effects from exports on delta hydrodynamics. The Delta has lost a diversity of ecosystem services benefits over the last 150 years as much of the land was 'reclaimed' for agriculture resulting in channelization of the waterways and an extensive system of levees. Along with these changes came invasive plants and animals that now make up the majority of the Delta's total biomass. Restoration of tidal habitats will reverse some of these changes and benefit multiple species of native fish and wildlife, especially listed salmonids and smelt. Tidal habitats provide multiple benefits including increased food availability and refuge from predators.
- Tracy and Skinner Fish Facility Improvements: Reclamation and DWR would continue to implement improvements to salvage facilities including:
  - Predator Removal: Reclamation would install a carbon dioxide injection device to allow remote controlled anesthetization of predators in the secondary channels of the Tracy Fish Facility.
  - Release Sites: Reclamation proposes to work with DWR to consider flexibility in salvage release sites, using DWR's sites, or sites on a barge.
  - These actions minimize the effects of salvage on listed salmonid species.

- Increased use of Joint Point of Diversion (JPOD): Reclamation and DWR propose several scenarios that would benefit from JPOD and would present a Fish Plan for each of those scenarios for programmatic SWRCB approval. *
- DCC Improvements: Reclamation may modernize DCC's gate materials and mechanics to include adding industrial control systems, increasing additional staff time, and improve physical and biological monitoring associated with the DCC daily and/or tidal operations as necessary to maximize water supply deliveries. Modernization could allow diurnal operation during closure periods in the 2009 NMFS BO.
  The Delta Cross Channel (DCC) is more than 65 years old and its gates rely on remote operators to travel to the facility to change their position. When the gates are open, they provide a critical diversion structure for freshwater reaching the CVP South Delta pumping station. The gates are closed to prevent scouring (during high flows), reduce salinity intrusion in the western Delta, and protect Sacramento River ESA-listed and non-listed salmonids. Frequent use of the DCC increases its risk of failure. Opening the DCC more frequently decreases salinity at Jones Pumping Plant and reduces the amount of outflow required to meet salinity requirements and therefore is desired.
  Safety issue to not have staff out there due to boats going under the gate.
  Additional DCC operation would allow for improved exports and water quality without additional adverse effects on salmonids.*
- Tracy Pumping Plant Improvements: Hybrid / hot start pump, hybrid pumps - can we use batteries at Tracy Pumping Plant?
- Salvage Improvements: Reclamation may improve the Tracy Fish Collection Facility to reduce loss by: 1) incorporating additional fish exclusion barrier technology into the primary fish removal barriers, 2) incorporating additional debris removal systems at each trash removal barrier, screen, and fish barrier, 3) Constructing additional channels to distribute the fish collection and debris removal among redundant paths through the facility, 4) Construct additional fish handling systems and holding tanks to improve system reliability, and 5) Incorporate SCADA into the design and construction of the facility.
  Facility improvements will improve survival of fish salvaged and potentially reduce the loss factors to allow for additional certainty on OMR management with low impacts from salvaging salmonids.*
- Skinner Fish Facility Improvements: DWR would work to reduce predation at Clifton Court and reduce pre-screen loss.
- Old River Habitat Improvements: Reclamation may address the predation caused by scour at the Old River / San Joaquin River junction. This would change local hydrodynamics to favor juvenile survival. This action would increase juvenile production and adjust salvage thresholds for OMR management.*
- Habitat Restoration: Reclamation and/or DWR may implement another 3,000 acres of pelagic habitat in the Delta. This would increase juvenile survival / growth for salmonids and improve Delta Smelt habitat.
- Food Web Augmentation
    - Colusa Basin Drain: Reclamation may work with partners to flush agricultural drainage (i.e. nutrients) from the Colusa Basin Drain through Knight's Landing Ridge Cut and the Tule Canal to Cache Slough, improving the aquatic food web in the North Delta for fish

species. Reclamation may work with DWR and partners to augment flow in the Yolo Bypass in July and/or September by closing Knights Landing Outfall Gates and routing water from Colusa Basin into Yolo Bypass to promote fish food production. Zooplankton produced on the Yolo Bypass would move downstream into an area where juvenile and adult delta smelt are known to occur at a time of year when food availability may be a limiting factor. Salvage flexibility would be increased corresponding to the effects on the juvenile population, if food is limiting.*

  - Sacramento Deepwater Ship Channel: Reclamation may repair or replace the West Sacramento lock system in order to hydraulically reconnect the ship channel with the main stem of the Sacramento River. When combined with an ongoing food web study, the reconnected ship channel has the potential to flush food production into the north Delta. An increase in food supply is likely to benefit Delta Smelt and their habitat. Salvage would be adjusted in accordance with the anticipated increase in juvenile abundance and Delta Smelt abundance, if food is limiting.*

- Delta Habitat Restoration: Reclamation may work to increase Delta pelagic habitat by 3,000 acres. The restoration could shrink water weeds, grow fish food, create habitat for Delta smelt and salmonids, and prevent salinity intrusion into the south Delta. Increases in growth and survival would lead to increased future year abundance, with a corresponding adjustment in future year salmonid salvage, if rearing habitat is limited.
- Georgiana Non-Physical Barrier: Emigrating salmonids, departing the Sacramento main stem, often enter into the interior delta at Georgiana Slough, where they undergo high rates of predation and entrainment. Reclamation, in coordination with DWR, may conduct a barriers project similar to the pilot studies conducting by DWR in 2011, 2012, and 2014. Reclamation and DWR will setup a bioacoustic fish fence at Georgiana Slough, along with a combination of different barriers (e.g. floating fish guidance structure) to direct fish into Sutter and Steamboat slough. The action would reduce the entrainment of fish into the Central / South Delta, and increase abundance of juveniles outmigrating in several years. Salvage would be adjusted accordingly.
- North Delta Arc Routing into Sutter and Steamboat Sloughs: The north Delta contains an "Arc" of suitable habitat for salmonid species in areas such as; Yolo Bypass, the Sacramento River, and Suisun Marsh. Reclamation may manage and implement barriers throughout the "Arc" to maximize the benefits of these habitats and direct listed salmonids into these habitats. The action would reduce the entrainment of fish into the Central / South Delta, and increase abundance of juveniles outmigrating in several years. Salvage would be adjusted accordingly.
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3.3.5 Scenario Development

Scenario development encourages participating entities to propose ideas they consider favorable to their point of view. In the context of SDM and its quantitative system models, those ideas are packaged as scenarios. A scenario contains a suite of management actions for input to the model, and evaluation of output by the Science Integration Teams and the Oversight Coordination Groups.

Scenarios can have life spans that range between short and very long. In the case of operations, the typical unit of measure is a water year. In the case of salmonids, 3-4 reproductive cycles of typically 4

years each, or a total of 12-16 years, is normal. CVPIA Science Integration Team tests scenarios for 25-year periods in their life cycle models.

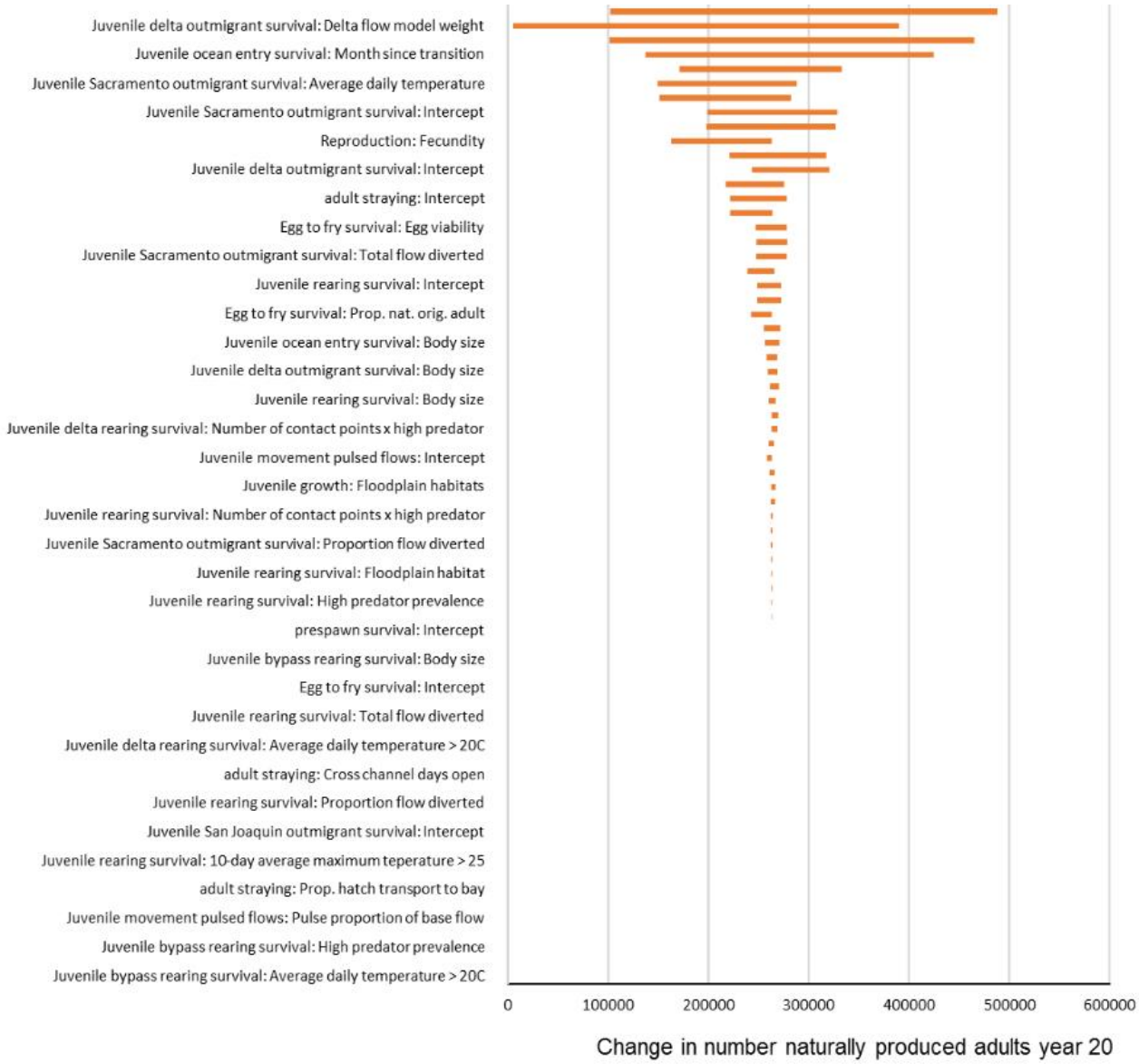
Scenario development requires coordination from all parties to marshal sufficient data, functional relationships, and associated information to populate the inputs per model specification. Scenario development also requires explicit articulation of the permissible actions available to the decision makers (unconstrained basic management actions) unconstrained by legal or political requirements. Optimally, the Science teams and Oversight groups generate a sufficient number of scenarios of sufficient variety to envelop the range of fish impacts and thus define the appropriate operational and infrastructure improvement boundaries.

Scenarios include unconstrained basic management actions, sets of management actions, sorted by type and seasonal application, and strategies of sets of management actions. The performance measure is the amount of operational flexibility gained under each scenario. The Science Integration Teams will make statements based on model output about how much operational flexibility yields from modeling the scenarios.

3.3.6 Uncertainty Reduction

3.3.6.1 Model Sensitivity Analyses

SDM uses sensitivity analysis to identify the scenario components that have the greatest effect on the expected value of the decision. During the one-way sensitivity analysis, values for model parameters (e.g., survival) are varied as a percentage of model values and the estimated response is recorded for the top scenario. It is useful to display the results of the sensitivity analysis graphically in a tornado diagram (Figure 3).



Source: USFWS and Reclamation 2017??

Figure 3. Tornado diagram from one-way sensitivity analyses of CVPIA fall run Chinook Salmon SDM components

In the Figure 3, the CVPIA Science Integration Team modeling in the Central Valley shows that of all the inputs, the top 5 to 6 have the most significant effect on the outcome. That designation puts a premium on reducing the uncertainty associated with each of those inputs. To reduce the uncertainty of those 5 to 6 inputs, the Regional Oversight Coordination Groups and the Science Integration Teams, can take the following steps.

3.3.6.2 Improve Ongoing Monitoring Efforts

The Science Integration Teams will be responsible for maintaining an inventory of monitoring in their respective areas. They will conduct periodic reviews of the monitoring testing the statistical power, protocols, QA/QC, and data management. They will be responsible for assessing if the monitoring

associated with the most sensitive model inputs is sufficient, i.e., occurring in the correct location, at the right time, frequency, and duration. The Science Integration Teams will be responsible for determining the priority for maintaining, upgrading, or modifying the ongoing monitoring to meet the overall goal of reducing model uncertainty.

3.3.6.3 Redirect Monitoring Efforts

If the information from an on-going monitoring effort is not directly reducing the uncertainty of a key model variable, or providing key calibration data, consideration must be given to terminating that monitoring effort and its resources redirected to monitoring efforts that reduce uncertainty.

3.3.6.4 Research

Monitoring observes or checks the progress of processes or phenomena over a period of time. This information is usually published and used in developing the conceptual and decision support models.

Research seeks to identify and quantify new or unconsidered facts and reach new conclusions. The science teams occasionally describe phenomenon or processes for which no standard monitoring exists. Research is necessary to quantify those phenomena or processes, so they can be simulated in the system model. The science teams will follow Agency standards for conducting research.

3.3.6.5 Implement Habitat Restoration and Facility Improvement Projects

One of the most useful modes of research, or uncertainty reduction, is the construction and direct monitoring of a prototype. For example, it was obvious that water diversions were a source of mortality for juvenile fish. It was equally obvious that a solution was to screen the diversion intakes to prevent entrainment of juvenile fish resulting in their inevitable demise. There was considerable uncertainty as to the design and operation of the screens regarding their impact on juvenile fish.

Prototype scale screens were constructed in laboratories and live juvenile fish released to interact with the screens. This led the researchers to establish the first criteria for the screen wiring and velocity fields near the screens. Demonstration screens were then constructed in the field under live conditions, using the laboratory derived design and operational criteria. The criteria continued to be refined based on monitoring in both the laboratory and field installations, and then adopted by the regulatory agencies for guiding the design and construction of screens throughout the Central Valley.

The field-based installations are the final phase of the adaptive management loop – the learning, or assessment phase. Here lessons are learned, hypotheses refined, designs improved operational parameters fine-tuned. Performance of the screens in situ are updated in the models resulting in better estimates of juvenile survival at water diversions.

3.3.7 Status and Trends Monitoring

Status and trends monitoring is the standard fish monitoring that the watershed groups will implement to tell Reclamation where the fish are in real-time

Status and trend monitoring tracks the performance of suites of management actions. All types of monitoring are designed to test the hypotheses of the conceptual model. Most of the monitoring follows standard fish monitoring protocols implemented via the watershed groups and/or agencies. Some monitoring has to be designed to test specific hypotheses and may not have an established protocol. One purpose of the monitoring is keep Reclamation informed of fish locations in real-time. In

general, trend monitoring tracks progress towards meeting the Fundamental Objectives. StatusPerformance monitoring identifies the progress towards meeting the Means Objectives.

3.3.7.1 Status or Performance Monitoring

Performance monitoring is used to determine, by causation, if a Program-funded action achieved the intended detectable change in environmental conditions or population characteristics. This is also known as "action effectiveness" monitoring, which targets specific limiting factors, and the associated mitigation actions taken to address them. If performance monitoring indicates that the adaptive management "restore" action did not have the anticipated effect, the provided operational flexibility would be adjusted accordingly, in coordination with the appropriate watershed group.

Performance monitoring would be based on a cause-and-effect scenario – implement a project or action, monitor the immediate species response, and identify the progress towards meeting the means objectives. This includes defining the structural and biological performance measures for success.

3.3.7.2 Long-Term Trend Monitoring

Long-term trend monitoring provides valuable insights into environmental changes and can highlight trends in important natural resources. Long-term trend monitoring provides an understanding of the long-term collective effects of management actions and shows progress towards meeting the fundamental objectives. This type of monitoring does not typically provide insight into immediate population reactions to a specific project, but instead is used to assess fish/habitat status over time to provide program evaluation and reporting needs. These are time series monitoring programs - adult abundance, adult/juvenile survival; changes in survival or productivity, distribution and diversity; fish migration patterns; predation patterns, foodweb changes.

4 Regional Collaboration, Reporting, and Science Review

4.1 Summary of Relationships to Other Programs

Other important efforts are currently operating to implement science-based adaptive management to improve the operational decisions on annual or multi-year time scales. The ROC on LTO AMIF is meant to reduce redundancy and accelerate a more efficient and flexible water and fish management strategy reflecting the status of species and operational capacity. In most cases, existing programs that the CVP and SWP utilize for coordination, communication, and collaboration can be augmented and enhanced to meet the challenges and integration facing water and fish managers over the next ten years.

4.1.1 CVPIA

The CVPIA goal is to double anadromous fish populations in the Central Valley, however, progress towards the CVPIA fish doubling goals for anadromous fishes so far has been challenging and changes in the program were necessary to improve performance. Recommendations were made to update and improve the programs science-based framework, reorganize the program structure and management, improve implementation by making full use of CVPIA water operations authorities, and improve collaboration with all related programs in the Central Valley. As a result, in 2015, Reclamation and the USFWS established the Science Integration Team. CVPIA Science Integration Team consists of a collaborative group of Central Valley river and Delta experts from agencies, water users, NGOs, and consultants, with a facilitator from the U.S. Geological Survey, and will be included in the Central Valley Watershed Oversight Group or the Delta Oversight Group (see Section 3.1.1.1).

The current CVPIA Science Integration Team developed DSMs Chinook salmon, steelhead, and sturgeon which will be used in the ROC on LTO SDM process.

4.1.2 CSAMP

Collaborative Science and Adaptive Management Program (CSAMP) is an applied science program specifically designed to inform decisions regarding operations of the CVP and SWP and species protection in the Delta. The Program was established in 2013 following the remand decision on the USFWS and NMFS Bos by the U.S. District Court for the Eastern District of California. The CSAMP has four tiers consisting of:

- Policy Group made up of agency directors and top-level executives
- Collaborative Adaptive Management Team (CAMT) made up of managers and staff scientists
- Scoping Teams established on an as-needed basis for specific studies
- Investigators to conduct studies

The Collaborative Adaptive Management and Policy Committee will collaborate with the CSAMP.

CAMT decides the priority issues. The CAMT is made up of a Smelt Scoping Team, a Salmon Scoping Team, technical experts, and a Delta Science Program. The Delta Science Integration Team will coordinate with the CAMT.

4.1.3 Interagency Ecological Program

The IEP, initiated in 1972, connects state and federal natural resource and regulatory agencies to monitor and study ecological changes and processes in the Delta. IEP performs fundamental long-term trend monitoring to develop a better understanding of the estuary's ecology and the effects of the SWP/CVP operations on the physical, chemical, and biological conditions of the estuary. Most of the monitoring under the IEP focuses on open-water areas and the major Delta waterways conveying water to the SWP/CVP facilities in the south Delta and downstream, including the entire Bay-Delta and portions of its watershed.

The IEP produces publicly accessible data that include fish and invertebrate status and trends, water quality, estuarine hydrodynamics, and foodweb monitoring. Because of the history, size, and scope of this program's monitoring and research efforts in the Delta, it will continue to be a primary component in the implementation of LTO's adaptive management and monitoring program.

The IEP is a five-tiered organization consisting of:

- Agency directors
- Coordination Team with senior-level managers overseeing the program
- Science Management Team (SMT) with managers and staff scientists that scope specific science studies
- Ad hoc project work teams that develop scientific study concepts for recommendation to the SMT. Includes agency staff, academics and stakeholders
- Investigators conducting scientific studies

The Collaborative Adaptive Management and Policy Committee will collaborate with the IEP Coordination Team, and the Species Monitoring Teams will coordinate with the IEP SMT.

4.1.4 Delta Stewardship Council, Delta Independent Science Board, and the Delta Science Program,

Delta Stewardship Council was created in legislation and is charged with achieving the co-equal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The Delta Independent Science Board (Delta ISB) is a standing board of prominent scientists with expertise to evaluate the broad range of scientific programs that support adaptive management of the Delta. The Delta ISB provide oversight through periodic reviews of the scientific research, monitoring, and assessment programs supporting adaptive management of the Delta. The overall objective of Delta ISB oversight is to facilitate the highest quality science underlying Bay-Delta programs, the application of that science, and the technical aspects of those programs. The Delta ISB reports to the Delta Stewardship Council.

The Delta Science Program was established to develop and synthesize unbiased, and relevant scientific information critical for managing the Bay-Delta system, which needs to be integrated across state and federal agencies, and communicated to Bay-Delta decision-makers, agency managers, stakeholders, the scientific community, and the public. The objectives of the Delta Science Program are to support research, synthesize scientific information, facilitate independent peer review and coordinate and communicate science.

The Delta Science Integration Team will incorporate the Delta Science Program DSM currently under development.

4.2 Reporting

4.2.1 Annual Work Plan and Budget

Annual work plans and budgets will be prepared for each upcoming year and will include the proposed activities of the adaptive management and monitoring program. The budget will identify projected expenditures and identify the sources of funding.

4.2.2 Annual Progress Report

Annual progress reports will be prepared at the end of each implementation year and will include existing information, data, and analysis. The report will include sufficient information to demonstrate that the actions are being implemented consistent with the provisions defined in the work plan, BO, and all associated regulatory requirements, or if not, what were the justifications of the revisions.

On or about the end of September of each year, Reclamation and DWR propose to provide to the USFWS, NMFS, and CDFW a report on the prior year activities through the spring of each year. The annual report shall include, at minimum:

- Hydro-Meteorology: Precipitation; reservoir inflow; air temperatures; and other environmental factors affecting water availability and demands.
- Non-Flow Construction: Summary of projects initiated; ongoing; and completed.
- Water Operations Summary: Conditions from the prior year; allocations; flows; diversions; and reservoir, release, and river temperatures.
- Fisheries Performance: Results from monitoring stations; surveys; salvage; harvest; and physical factors influencing fish populations.
- Intervention Measures: Hatchery intakes; releases; and other measures.
- Predictive Tools: Summary of the performance of the risk analysis tools used during the year.

4.3 Federal Agency Decision-Making and Issue Resolution Process

SDM is intrinsically an issue resolution process – especially science related or technically oriented issues. Identifying and separating objectives, utilization of observed data, and generation of conceptual and quantitative models are consensus-based activities in SDM. Scenario development encourages individual entities to propose ideas they consider favorable to their point of view. Interpretation of model results shows likely outcomes of scenarios and fosters selection of actions that are satisfying to the participants. Science-based issues should be sent back to the Science Integration Teams for reconsideration using the SDM process. Policy issues should be sent to the policy groups for resolution via traditional conflict resolution methods.

5 Funding

Reclamation anticipates allocating the Bay-Delta Fund (approximately $20 million), Reclamation Bay-Delta Office Water and Related Resources funding (approximately $20 million), as well as non-refuge CVPIA funds (approximately $20 million) using this process. This comes to a total of approximately $60 million per year. Water users or other stakeholders may also be interested in spending their funding on the most bang for the buck actions as identified through this process.

It is anticipated that if design and environmental compliance can be completed with these funds, large projects could be ready for other possible future sources of large appropriations (i.e. bond measures, American Recovery and Reinvestment Act).

6 Appendices