

Collaborative Science and Adaptive Management Program Triennial Report 2016 - 2018

Prepared for:

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Table of Contents

1.0	Introduction	1
1.1	History	1
1.2	Organization	2
2.0	CSAMP Re-Focused	2
2.1	Purpose	2
2.2	Approach	3
2.3	Scope	4
3.0	Policy – Science Dialog	4
4.0	Decision Support Science	6
4.1	Structured Decision Making (SDM) for Delta Smelt Recovery	6
4.2	Winter-Run Life Cycle Model Workshops.....	8
4.3	Plan to Assess the Effects of Ambient Environmental Conditions and Flow-Related Management Actions on Delta Smelt	8
4.4	Defining Juvenile Salmon Rearing Habitat in the Delta.....	11
5.0	Management Action Support	11
5.1	Delta Smelt Resiliency Strategy	11
5.2	Sacramento Valley Salmon Resiliency Strategy.....	13
5.3	Other Near-term Actions for Salmonid Recovery.....	14
6.0	Targeted Research to Address Key Management Questions.....	14
6.1	Salmonid Behavior, Migration and Survival in the Delta.....	14
6.2	Improved Application of Delta Smelt Survey Data.....	15
6.3	Old and Middle River (OMR) Flow Management and Entrainment of Adult Delta Smelt.....	15
6.4	Fall Outflow Management for Delta Smelt.....	16
7.0	Program Management and Expenditures	16
8.0	Priorities for 2019 and 2020	18

List of Figures

Figure 1 - TWG Recommendations Resulting from the SDM Delta Smelt Demo Project6

List of Tables

Table 1– CSAMP Decision Support Initiatives 5
 Table 2 - Capital Expenditures16
 Table 3 - Capital Expenditures by Entity16

List of Attachments

- A. CSAMP Roles and Responsibilities
- B. SDM Demonstration Project Report
- C. Executive Summary from SST Report - *Effects of Water Project Operations on Juvenile Salmonid Migration and Survival in the South Delta*
- D. CAMT Salmon Workshop Summary
- E. Summary of Findings from Review of Survey Data for Adult Delta Smelt
- F. Summary of Findings from Entrainment Study 1 for Adult Delta Smelt

1.0 Introduction

This report summarizes activities of the Collaborative Science and Adaptive Management Program (CSAMP or Program) during calendar years 2016, 2017 and 2018.

Throughout the report, the term “CSAMP” is used to refer to the overall program, which encompasses the Collaborative Science and Adaptive Management Team (CAMT), the Policy Group, Scoping Teams and various subcommittees. The term “CAMT” refers specifically to the team of individuals that make up CAMT.

Over the past three years, CSAMP has expanded its membership and refined its purpose. CSAMP continues to serve as a forum for communication, coordination and engagement on matters associated with the conservation of listed fish within the Sacramento San Joaquin Bay-Delta Estuary and the operations of the Central Valley Project (CVP) and the State Water Project (SWP).

Information developed by CSAMP is intended to facilitate more effective management decisions, including regulatory decisions, but CSAMP does not directly engage in ongoing regulatory proceedings such as the Re-initiation of Consultation for Long-term Water Operations (ROC) or the Water Quality Control Plan update. These regulatory proceedings have their own formal processes for participation by CSAMP members and other stakeholders.

1.1 History

Federal and state agencies proposed establishment of the CSAMP in late 2012 amidst ongoing litigation over the 2008 and 2009 Biological Opinions (BiOps) addressing the impacts of continuing operation of the Central Valley Project and State Water Project on listed species. CSAMP was launched following a decision by the United States District Court for the Eastern District of California on April 9, 2013, to extend the court-ordered remand schedule for completing revisions to Biological Opinions.

The Court Order allowed the parties making the motion (i.e., U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the California Department of Water Resources) additional time to develop a proposed robust science and adaptive management program. This program would include collaboration of the scientists and experts from Public Water Agencies (PWAs) and non-governmental organizations (NGO's) to inform the management actions incorporated into the existing BiOps (and Reasonable and Prudent Alternatives) and consider alternative management actions.

In 2015, the Ninth Circuit reversed the Court's decision with respect to the smelt and salmonid BiOps and issued a final judgment, thereby ending the Court Order. In the absence of the Court Order, all parties agreed to continue the CSAMP to promote the collaborative development of scientific information to inform sound decision-making into the future.

1.2 Organization

The CSAMP is structured as a four-tiered organization comprised of:

1. **A Policy Group** consisting of agency directors and top-level executives from the entities that created CSAMP;
2. **The CAMT** made up of managers and senior level scientists that serve at the direction of the Policy Group;
3. **Scoping Teams and Subcommittees** created on an as-needed basis to scope specific science studies or discuss study results; and
4. **Investigators** contracted to conduct studies.

In 2016, CSAMP expanded its membership to include additional water contractors representing upstream and in-Delta interests and additional environmental non-governmental organizations (NGOs). In 2016, CSAMP also retained a full-time Program Manager.

A listing of current Policy Group, CAMT, and scoping team members is provided at the beginning of this report. Attachment A provides a listing of roles and responsibilities for the different CSAMP teams.

2.0 CSAMP Re-Focused

2.1 Purpose

Since its inception in 2013, CSAMP has been focused on the management of CVP and SWP water project operations and how those operations affect listed fish species, particularly Delta Smelt and salmonids.

As CSAMP has transitioned from a court-ordered program to a voluntary collaborative with an expanded membership it has revisited its purpose, approach, and scope. In 2016, the CSAMP Policy Group adopted a list of actions for advancing the collaborative that, among other things included:

- *Maintaining focus on the original science questions, including moving the information through the adaptive management process to inform management actions.*
- *Broadening CSAMP's scope to include consideration of science-based management actions that could contribute to conservation of species of concern that use the Delta;*
- *Maintaining flexibility to address emerging science and information needs regarding water management and species of concern in the Delta;*

- *Coordinating with other programs, including the Interagency Ecological Program (IEP), the United States Geological Survey (USGS) and EcoRestore to avoid duplication, minimize take, and promote collaboration and knowledge transfer.*

In February 2017, the CSAMP Policy Group adopted the following updated purpose statement as well as the approach and scope language provided in the following sections:

Work with a sense of urgency to collaboratively evaluate current hypotheses and management actions associated with protection and restoration of species of concern, current and future federal and state regulatory authorizations for the SWP and CVP, and other local and state management actions, to improve performance from both biological and water supply perspectives.

2.2 Approach

In addition to a revised purpose statement, the following approach was adopted by the CSAMP Policy Group at its February 2017 meeting:

The CSAMP seeks to achieve its purpose through the following:

- 1. Provide a FORUM for communication among the agencies, NGOs and PWAs;*
- 2. Act as a CATALYST to address the most contentious and urgent management relevant science issues; and*
- 3. COMPILE AND DISSEMINATE INFORMATION for decision makers on contentious and urgent science issues in a timely fashion.*

FORUM – CSAMP should be a venue where issues, alternative hypotheses, and alternative management approaches can be thoroughly and openly discussed by all involved agencies and stakeholders. It should be a forum for meaningful discussion that promotes understanding, identifies areas of agreement and disagreement, and facilitates better informed management decisions. If an issue is not to be heard, all should understand why. CSAMP is not a decision-making body and should not become an institution in-and-of itself.

CATALYST - CSAMP should (1) be a catalyst for integration of scientific information to inform policy makers and (2) be a venue for proposing and vetting potential changes to management actions and monitoring schema based on such information in order to maximize their effectiveness while minimizing their costs and impacts on society, recognizing that decisions regarding changes must ultimately be made by the agency or agencies with decision-making authority. Part and parcel of this effort, CSAMP should address urgent and contentious issues taking the initial steps to define the issue, define the differences in understanding and areas of agreement and

disagreement, promote common understanding (narrow the differences) and fund science where appropriate, and tee up trade-offs for policy makers. If the activity requires a long-term investment, CSAMP should find the appropriate entity to address the issue and report back to CSAMP on a regular basis.

COMPILE AND DISSEMINATE INFORMATION - CSAMP should be the trusted provider of key information. This includes compilation of data, analyses of findings, critical assessment of that information, and synthesis of that information in order to aid policy makers. The information provided should be complete; with the pros and cons as appropriate. CSAMP should not strive for consensus, but it should always provide well thought out information and associated rationale. Members must be able to understand the source and essence of both agreement and disagreement being discussed.

2.3 Scope

In February 2017, the CSAMP Policy Group adopted the following language to clarify the scope of its activities, including maintaining the flexibility to address emerging science in the Delta and upriver, and a committing to coordination with other science programs.

The CSAMP was originally established, and continues to focus on science and adaptive management issues related to current and future biological opinions for SWP and CVP operations, including the science underlying specific actions contained in the reasonable and prudent alternatives (RPAs). However, CSAMP has identified the need to maintain the flexibility to address emerging science and information needs regarding water management and species of concern in the Delta and upriver, including actions to improve the resiliency of Delta Smelt and salmonids. CSAMP is also committed to coordinating with other programs, such as the Interagency Ecological Program (IEP), Central Valley Project Improvement Act (CVPIA), NOAA South West Fisheries Science Center (SWFSC), and Delta Stewardship Council-Delta Science Program (DSC-DSP) to avoid duplication, minimize take, and promote collaboration and knowledge transfer.

3.0 Policy – Science Dialog

Between 2016 and 2018, CSAMP held several Policy-Science fora where dialogue between Policy Group members, CAMT members and technical staff occurred on the following topics:

- August 2016 – Outflow Augmentation
- March 2017 – Winter-run Life Cycle Model
- May 2017 – Fall Outflow
- July 2018 – Delta Smelt Entrainment
- December 2018 – Delta Smelt Surveys

The intent was to facilitate dialog between technical experts, among technical experts and policy makers, and among policy makers to increase understanding of the current state of knowledge regarding a given topic or issue.

The explicitly stated goals of the fora were to:

1. Create a constructive learning environment
2. Explore and share data and interpretations of relevant science among all participants
3. Build relationships
4. Inform future policy discussions and decision making
5. Allow for presentation of differing views in a collaborative environment

Technical presentations were focused on addressing the following questions:

1. Proposed management actions:
 - 1.1 What is the evidence for and against the proposed action?
 - 1.2 What is our current understanding of the potential benefits, costs and risks?
 - 1.3 What are the areas of scientific agreement and disagreement?
 - 1.4 What additional technical information do policy makers need to make a decision?
2. Outcomes of management actions
 - 2.1 What modeling and monitoring were conducted to evaluate outcomes of actions?
 - 2.2 What were the results of the actions in terms of environmental responses?
 - 2.3 What interpretations are possible relevant to the goals of the actions?
3. Technical studies
 - 3.1 What were the scientific findings of the studies; what were the uncertainties; what are the agreements and disagreements about interpretations of the findings?
 - 3.2 What is the policy relevance of the findings?

The fora provided opportunities for identifying areas of agreement and constructive disagreement about findings and outcomes. The dialogue about studies and outcomes of actions promoted information sharing and learning and encouraged discussion of the advantages and disadvantages of alternative strategies and relevance to policy of interpretations.

4.0 Decision Support Science

The CSAMP has initiated several projects over the past three years specifically aimed at supporting decision making as highlighted in Table 1 below.

Table 1 – CSAMP Decision Support Initiatives

CSAMP Initiative	How it Supports Management Decisions
Structured Decision Making (SDM) for Delta Smelt	Directly support future decision-making by providing transparent processes for evaluating trade-offs and understanding uncertainties associated with various management choices.
Winter-run Chinook Salmon Life Cycle Model (LCM) Workshops	Improve understanding and application of existing tool used to predict the effects of management actions on Winter-run Chinook salmon. Increased stakeholder confidence and model enhancements.
Science Plan for Delta Smelt Flow-related Actions	Provide a framework for directly connecting science information and management decisions.
Defining Juvenile Rearing Habitat in the Delta	Inform future Prop 1 proposals and associated restoration investment decisions.

Each of the above initiatives are described in more detail below.

4.1 Structured Decision Making (SDM) for Delta Smelt Recovery

In 2017, CAMT engaged Compass Resource Management Ltd (Compass) to conduct a demonstration SDM process examining actions in the Delta Smelt Resiliency Strategy.

Working collaboratively with a Technical Working Group (TWG) selected by CAMT, Compass led a preliminary, multi-objective analysis of the 13 actions in the Delta Smelt Resiliency Strategy. Over the course of several months, the TWG worked through the typical steps of an SDM process, including:

- clarifying the decision context;
- defining an objectives hierarchy and associated performance measures;
- developing alternatives; and
- estimating consequences, evaluating trade-offs and making recommendations.

Many assumptions were made in developing this demonstration analysis. While substantial uncertainties remained and the results (i.e. estimated consequences) could only be presented alongside an emphasis of caveats for their interpretation, the TWG felt that the analysis and deliberation within the SDM process enabled them to make defensible recommendations on the relative priority of the Delta Smelt Resiliency Strategy (RS) actions over the next few years (

Figure 1).

Figure 1: TWG recommendations resulting from the SDM Delta Smelt Demo Project

<p>Continue as planned</p> <ul style="list-style-type: none"> • North Delta Food Web • Suisun Marsh Salinity Control Gates • Managed Wetland Flood/Drain Operations • Roaring River Distribution System • Near-term DS Habitat Restoration • Rio Vista Research Station and FTC 	<p>Investigate further</p> <ul style="list-style-type: none"> • Aquatic Weed Control • Spring/Summer Outflow Augmentation • Sediment Supplementation in the LSZ • Stormwater Management • Franks Tract
	<p>Reconsider</p> <ul style="list-style-type: none"> • Spawning Substrate Augmentation • Adjust Fish Salvage Operations

The results of the demonstration project were presented to the CSAMP Policy Group at their January 31, 2018 meeting and a detailed results summary report was written and circulated (see Attachment B).

This project demonstrated the usefulness of organizing available information into a consequence table to display expected performance of the management actions and trade-offs across objectives. However, to populate the consequence table within the timeline of the project, judgements had to be made by the TWG on the most important lines of inquiry to examine in this ‘first pass’ and which lines of inquiry to set aside for future iterations of analysis. In particular, the management actions in the “Investigate further” category are actions that the TWG indicated as requiring more information and/or analysis to better inform future decisions.

Based on the success of the demonstration project, CAMT asked Compass to conduct a scoping exercise in late 2018 to explore additional SDM work that could be done regarding Delta Smelt management and recovery. Key questions explored included:

- What decisions related to Delta Smelt could benefit from a SDM process?
- What is CSAMP trying to achieve with starting a new SDM process for Delta Smelt?
- What is CSAMP’s role in informing decisions on Delta Smelt?
- What are the connections between CSAMP’s SDM work on Delta Smelt and the work of others?
- What are key process considerations for designing a SDM process for CSAMP?

Results of the scoping exercise indicated the following:

- **CSAMP members are aligned in wanting better outcomes for Delta Smelt.** CSAMP members described this goal as “reversing the population decline trajectory” and “maintaining some level of viable population”.

- **CSAMP can be a catalyst for advancing action on Delta Smelt in many areas – decision making, learning, and implementation of management actions.** CSAMP can also provide a valuable leadership role to facilitate better practices and coordination across the many actors, initiatives, and regulations that influence Delta Smelt.
- **CSAMP members have an interest in using SDM to inform an array of decisions related to Delta Smelt.** Some CSAMP members are most interested in strategic decisions, for example – ‘what are the highest priority management actions for Delta Smelt?’ Other CSAMP members have indicated interest in a SDM process to inform whether or how to do specific management actions such as Franks Tract, conservation hatchery, and managing OMR flows.
- There is a desire for a **comprehensive multi-species/ecosystem approach** for making decisions – such an approach would examine the habitat needs of multiple native species to develop strategies that create the most benefits across those species. However, there is also a concern that spreading analytical resources too thinly could undermine efforts to focus effectively on priority issues.

Based on results of the scoping exercise outlined above, the CSAMP Policy Group, at its December 14, 2018 meeting, asked Compass to use SDM and facilitation methods to assist CSAMP to make more informed, transparent, and defensible recommendations on a portfolio of prioritized management actions and science activities to advance Delta Smelt recovery.

CAMT is currently working with the U.S. Bureau of Reclamation (USBR) and the Delta Science Program (DSP) to identify how this next Delta Smelt SDM effort can be integrated with the ongoing Delta SDM initiative being led by the DSP.

4.2 Winter-Run Life Cycle Model Workshops

In 2017, CAMT, working closely with the National Marine Fisheries Service (NMFS) and the Southwest Fisheries Science Center initiated a series of workshops to advance stakeholder understanding of the existing Winter-run Chinook Salmon Life Cycle Model (LCM) developed by NMFS Southwest Fisheries Science Center (SWFSC), and to explore model uses and limitations as well as potential refinements.

Over the course of 2017 and 2018, NMFS has hosted five full-day workshops to review elements of the LCM and discuss its potential application to key management questions.

4.3 Plan to Assess the Effects of Ambient Environmental Conditions and Flow-Related Management Actions on Delta Smelt

In 2018, CAMT commissioned development of a Plan to provide a programmatic framework to develop, assess, and evaluate data and research findings to understand

how Delta Smelt respond to changing environmental conditions. The focus of the plan is on development, assessment, and evaluation of data and research findings with respect to certain flow-related management actions. The work was conducted in coordination with other ongoing activities relevant to Delta Smelt and leveraged data and research findings from multiple sources. The focus of the Plan is on understanding the role of actions such as seasonal outflow management, Toe Drain flows, and Suisun water management, in the context of non-augmented conditions with the expectation that the framework could eventually be extended to include other actions.

There have been a number of concerted efforts to scientifically evaluate the effects of flow actions including the FLaSH studies for the 2011 Fall Outflow Action (Brown et al., 2014), the FLOAT and Directed Outflow Program (DOP) studies undertaken in relation to the 2017 Fall Outflow action, and studies of specific regional effects, e.g., (Frantzich et al., 2018). However, these past efforts have yielded mixed results that are characterized by a significant degree of uncertainty regarding the hypothesized link between flow-related management actions and improved performance of Delta Smelt. The objective of the Plan was to show how existing scientific activities can be leveraged and enhanced, how specific research can be used to increase understanding, how predictions and efficiency can be improved and how findings can be developed and applied to an ongoing program of actions to benefit Delta Smelt.

The Plan provides a framework for ongoing assessment and evaluation of data and research findings to increase mechanistic understanding of how Delta Smelt respond to changing environmental conditions. The Plan recommends the following:

1. Establish the position of Science Program Manager to enable collaborative, coordinated, and effective generation and delivery of scientific information around Delta Smelt response to changing ambient conditions and flow-related management action.
2. Adopt a Three-Year Science Planning process, with provisions for Annual Supplements; initiating a structured approach to planning, coordinating and communicating scientific activities does not depend on any specific programmatic structure being in place.
3. Advance an integrated process-based tool to predict the effects of annual flow-related management actions and changing ambient conditions on Delta Smelt. Development of this tool will require several years and dedicated resources. The first step is to develop a detailed approach and proposal to set appropriate expectations, timelines and resource needs.
4. Establish an independent science advisory panel, using the guidelines in the Delta Science Plan, to provide timely advice on the potential utility of approaches to non-take detection of Delta Smelt, possible pitfalls, appropriate caveats, and useful steps to refine and test such approaches individually or in combination.

5. Convene a workshop on new techniques for aquatic field surveys in the Delta focusing on abiotic and biotic aspects of ‘dynamic habitat’ in the estuarine environment.
6. Explicitly request proposals relevant to understanding Delta Smelt flow-related management actions (e.g., interacting effects of dynamic and structural habitat on food availability, response of Delta Smelt and their prey to contaminant mixtures found in Delta water) as part of existing and future solicitations that include Delta-focused scientific study.
7. Conduct an inventory of existing information on the isotopic signatures of key potential carbon sources, including information about potential temporal and spatial variability, and where existing information is adequate.
8. Engage the Contaminants PWT to plan a series of specific experiments that build on existing work, and select focus locations for water collection where Delta Smelt are often caught and where contaminants are known to be an issue.
9. Convene a work group of managers and scientists (drawing in those outside of CSAMP participation as appropriate) that includes participation from the Delta Science Program and IEP, to develop a multi-year list of synthesis topics (e.g., issues, locations, species life stages/transitions) for which data/information is expected to be available, the types of synthesis outputs needed, and estimates of resource needs.

While there is, as yet, no specific management program that is a direct ‘user’ of the information and learning intended to be generated by future implementation of this Plan, it has been formulated to relate directly to established programs such as IEP and the Delta Science Program. In addition, implementation of this program should:

- Link directly to an adaptive management program for flow actions by developing and packaging scientific information in a way that it can be readily used to inform effects analyses, populate management-relevant numerical models, evaluate project performance by assessing progress against triggers and objectives, and refine future directed management actions, etc.
- Utilize and inform structured decision making (SDM). SDM could be used to collaboratively identify scientific activities to be undertaken, and predictive models suggested here could inform future SDM processes. As SDM is still being ‘piloted’ in the Delta, it has not been directly incorporated in this plan.
- Be adapted to apply to a broader and more complete set of management actions, e.g., habitat restoration, and/or other species, e.g., longfin smelt. Many of the approaches laid out are not restricted to either Delta Smelt or flow actions even though that is the focus of the report.

4.4 Defining Juvenile Salmon Rearing Habitat in the Delta

Restoring aquatic habitats in the Delta to improve rearing conditions for juvenile salmonids has been identified as a common goal in numerous programs and plans including the Delta Plan, EcoRestore, the Central Valley Project Improvement Act, the Delta Conservation Framework, the Sacramento Salmonid Resiliency Strategy and the 2009 Biological Opinion for operation of the State Water Project and Central Valley Project. However, little is known about juvenile salmonid use of the Delta (particularly for smaller rearing fry) or the characteristics that define quality habitat.

In August of 2018, in collaboration with the Delta Conservancy and the Delta Science Program, CSAMP jointly funded a study to define and map juvenile rearing habitat in the Delta.

The objectives of the study include:

1. Providing a meta-analysis of existing information regarding criteria for juvenile salmon rearing habitat and defining Delta rearing habitat criteria;
2. Establishing habitat selection criteria for salmon rearing in the Delta; and
3. Identifying near-term and long-term priorities for aquatic habitat restoration in the Delta that can be funded by Prop. 1 and other funding sources.

This study is expected to be completed in September 2019.

5.0 Management Action Support

The CSAMP has taken an active role in supporting the implementation of several management actions intended to improve conditions for Salmonids and Delta Smelt, while at the same time providing valuable learning opportunities. These actions have generally been associated with the Delta Smelt Resiliency Strategy and the Sacramento Valley Salmon Resiliency Strategy developed by the California Natural Resources Agency (CNRA). However, CSAMP has also identified other near-term management actions that could benefit from approaches using adaptive management frameworks, particularly for salmonids.

5.1 Delta Smelt Resiliency Strategy

Published in July 2016, the Delta Smelt Resiliency Strategy is a document prepared by the California Natural Resources Agency to address immediate and near-term needs of Delta Smelt, and to promote their resiliency to drought conditions as well as future variations in habitat conditions. The Strategy describes actions intended to benefit Delta Smelt. Its authors recognize that the feasibility and effectiveness of many of the actions identified in the Strategy require further study.

The Delta Smelt Resiliency Strategy states that:

The Collaborative Science and Adaptive Management Program (CSAMP) will be used to determine the appropriate research approach to designing and assessing the outcomes of these management actions individually and synergistically. The CSAMP forum will oversee implementation and the synthesis of the results to inform subsequent management actions.

In response to the above mandate, CAMT considered the thirteen actions identified in the Strategy and recommended two levels of engagement based on the current level of development and planning associated with each action, the need for additional scientific input, and the capacity of CSAMP to provide support.

Level 1 - *Active engagement in the research design (including evaluation of the existing scientific basis for the action), development of an appropriate monitoring program and analysis of monitoring data to assess performance.*

Level 2 - *Review of proposed research, monitoring plans, and evaluations prepared by others.*

CAMT also recommended tracking implementation of all the actions and providing regular updates to the Policy Group, including communicating monitoring and evaluation results. The CSAMP Policy Group adopted the CAMT recommendations at its July 18, 2016 meeting.

Since 2016, CSAMP has actively engaged in the following actions:

1. Flow Augmentation
2. Reoperation of the Suisun Marsh Salinity Control Gate

With regard to Flow Augmentation, CSAMP organized a series of meetings in late 2016 and early 2017 to discuss the basis for the potential action and the monitoring data (including field crews and permit authorizations) that would be needed to evaluate performance. These discussions led to the formation of an Interagency Ecological Program (IEP) Project Work Team (PWT) entitled “FLoAT” which provided input regarding data collection and interpretation in 2016 and 2017 and led to the formation of a FLoAT Management and Synthesis Team (MAST) to synthesize information regarding recent flow augmentation activities, including implementation of the Fall X2 RPA in 2017.

With regard to the Suisun Marsh Salinity Control Gates, the State Water Contractors, in coordination with CSAMP, funded development of a detailed adaptive management and monitoring template in 2017 that was referenced in a proposed action plan in 2018. The CSAMP also played a role in facilitating discussions regarding flow releases to

ensure compliance with D-1641 Water Quality Standards during project implementation.

In addition to focused efforts on the above two actions, the CSAMP policy, management and technical teams have received regular updates on other actions, including the North Delta Food Web Action, Franks Tract restoration feasibility study, and sediment supplementation in the low salinity zone.

5.2 Sacramento Valley Salmon Resiliency Strategy

Published in June 2017 by the California Natural Resources Agency, the Sacramento Valley Salmon Resiliency Strategy (SVSRS) is a science-based document prepared to address specific near- and long-term needs of Sacramento River winter-run Chinook salmon (winter-run), Central Valley spring-run Chinook salmon (spring-run), and California Central Valley steelhead (steelhead). The Strategy mirrors the approach taken with the Delta Smelt Resiliency Strategy. The Strategy relies heavily on the NMFS Final Recovery Plan for winter-run salmon, spring-run salmon, and steelhead, and is guided by conceptual models of factors driving winter-run population dynamics at key life stages being developed by teams addressing salmon and sturgeon indicators by life-stage (SAIL).

The SVSRS states that:

Implementing entities will consult with the Collaborative Science and Adaptive Management Program (CSAMP) to:

- 1. Assist with the research design – including evaluation of the existing scientific basis – and development of a monitoring and evaluation program to assess the performance of selected actions.*
- 2. Review proposed research, monitoring plans and evaluations prepared by others as requested for select actions.*
- 3. Periodically report back to the CSAMP Policy Group and interested parties on the implementation of all actions.*

CSAMP will focus on actions that are contentious and/or involve scientific disagreements regarding effectiveness.

The CAMT has reviewed the actions identified in the SVSRS and is currently recommending that CSAMP focus initially on those actions that are in the Yolo Bypass and Delta, namely Yolo Bypass Fish Passage, implementation of a non-physical barrier at Georgiana Slough and implementation of Tidal Mash restoration.

5.3 Other Near-term Actions for Salmonid Recovery

A subcommittee of CAMT has compiled a matrix of salmon recovery actions with the goal of evaluating the status of the various actions and identifying areas where CSAMP engagement could be helpful. This matrix includes the actions identified in the SVSRS, as well as others identified by the Central Valley Salmon Habitat Partnership and commercial fishing interests. These and other proposed actions will be evaluated by CAMT in 2019.

6.0 Targeted Research to Address Key Management Questions

6.1 Salmonid Behavior, Migration and Survival in the Delta

Salmonid survival in the southern Delta was a key factor considered by NMFS in the 2009 Biological Opinion and recovery planning for assessing population resiliency and population recovery. There are a range of views regarding the effects of south Delta hydrodynamics, as affected by San Joaquin and Sacramento River inflow and/or Delta exports, on the survival of salmonids emigrating through the south Delta.

In early 2017, the CAMT Salmon Scoping Team (SST) completed its review and synthesis of available science on salmonid survival in the south Delta and released its final report entitled *“Effects of Water Project Operations on Juvenile Salmonid Migration and Survival in the South Delta”*. In addition to providing a synthesis of available data, the report summarizes areas of scientific agreement and disagreement and indicates fruitful areas for expending funds on additional research to narrow areas of disagreement. The report also addresses eight specific management questions provided to the SST by CAMT. A copy of the executive summary from the report is included as Attachment C.

As part of the SST review, CAMT recommended funding for 12 additional JSAT receivers in January 2016 to supplement planned salmonid field studies in 2016. Deployment of the additional receivers provided data to improve the Juvenile Production Estimates (JPE) which are used to set take limits and provided data for better estimates of in-Delta survival and abundance. Data were collected primarily for Winter-run Chinook salmon, but these receivers could be used to also collect data for Fall-run Chinook salmon.

Based in part on the work of the SST, CAMT organized a stakeholder workshop in May 2018 to solicit additional information on the key management questions as well as information on broader questions of salmon recovery beyond the effects of the CVP and the SWP in the Delta. Results from the workshop were summarized in a report that was provided to all workshop participants (see Attachment D).

6.2 Improved Application of Delta Smelt Survey Data

Early in the formation of CSAMP, a question was raised regarding the adequacy of the existing survey data for evaluating impacts to Delta Smelt, specifically: *“Are there biases in the Delta Smelt survey data, and if so, how should the survey data be utilized?”*

To address the above question, CAMT commissioned a study to evaluate foundational assumptions that underlie data analysis methods used to draw conclusions about the population status of Delta Smelt. The study specifically evaluated assumptions regarding catchability and temporal and spatial autocorrelation. A summary of findings from the investigation is included in Attachment E.

6.3 Old and Middle River (OMR) Flow Management and Entrainment of Adult Delta Smelt

Two high priority CAMT Workplan elements identified in 2014 focused on OMR flow management and questions regarding Delta Smelt entrainment at the CVP and SWP export facilities in the south Delta. The CAMT funded a series of studies to examine the following two questions:

1. What factors affect adult Delta Smelt entrainment, and how can these factors be defined and managed to reduce entrainment risk?
2. What are the effects of entrainment on the Delta Smelt population?

While these investigations have taken significantly longer than originally anticipated and have still not been completed, CSAMP received reports on some of the findings in 2018

- The first study provides a retrospective analysis of historical data to improve understanding of factors that affect entrainment risk. The study examines the existing conceptual models to determine if new studies or information can be used to better understand salvage patterns.
- The second study uses a suite of hydrodynamic, water quality, and particle tracking models, referred to collectively as an individual-based model (IBM), to identify adult Delta Smelt behaviors that best explain movement towards SWP and CVP, as well as entrainment.
- The third study estimates adult Delta Smelt proportional losses to SWP and CVP entrainment, using the modeling tools developed in study two above.
- A fourth study was originally considered which would have re-examined life cycle model results published by Maunder and Deriso (2011) using updated data sets (i.e., post-2005) and revised assumptions, but given limitations in available data. there are questions regarding the utility and applications of study findings

The CAMT organized a Policy-Science forum with the CSAMP Policy Group on the first study in July 2018. Future fora are planned for the second and third studies in 2019. A summary of findings from the first investigation is included in Attachment F.

6.4 Fall Outflow Management for Delta Smelt

Another high-priority 2014 Workplan element for Delta Smelt involved looking at the importance of fall outflow. A study was commissioned to address the question:

Under what circumstances do environmental conditions in the fall, including fall outflow, contribute to determining the subsequent abundance of Delta Smelt?

Work on this study is ongoing, with findings expected in late 2019. This study has also taken significantly longer than originally anticipated.

7.0 Program Management and Expenditures

The CSAMP relies on a combination of agency staff and contractor support to conduct its work, including facilitation, program management and science investigations.

Program activities are generally classified according to the following:

1. **Management and Facilitation:** Includes: (a) management and facilitation of Policy Group meetings, CAMT meetings, and Scoping Team meetings; (b) management of contracts for CAMT support and technical investigations; and (c) planning and coordination, including development of annual work plans and budgets.
2. **Sponsored Participants:** Provides funding for contractors representing NGOs on CAMT, CAMT subcommittees and scoping teams.
3. **Technical Studies:** Represents investigations developed based on extensive dialogue within the CAMT and its scoping teams.

Over the three-year period (2016, 2017 and 2018), CSAMP members expended a total of \$4.3 million on the program with \$2.5 million of that total being spent on technical studies. Table 2 provides a breakdown of capital expenditures according to the categories listed above. Table 3 provides a breakdown of total capital expenditures by CSAMP members over the three-year period (2016-2018).

In addition to capital expenditures, it is estimated that CSAMP participants contributed approximately 5-6 full-time equivalents (FTEs) annually in the form of in-kind staff commitments to the Program.

Table 2 – Capital Expenditures (\$)

Activity	2016	2017	2018	Total
Management and Facilitation	392,700	425,800	357,900	1,176,400
Sponsored Participants	153,300	280,900	179,000	613,200
Technical Studies	1,240,900	780,300	503,200	2,524,400
Total	1,786,900	1,487,000	1,040,100	4,314,000

Table 3 – Capital Expenditures by Entity (2016 -2018)

Entity	Amount
NMFS	\$ 167,800
FWS	\$ 64,700
USBR ¹	\$ 1,205,700
CDFW	\$ 125,000
DSP	\$141,600
DWR ¹	\$ 1,771,500
PWA ²	\$ 837,700
Total	\$ 4,314,000

¹ A portion of the expenditures contributed by federal and state agencies is money collected from public water agencies.

² CCWD, MWD, SFCWA, SLDMWA, SWC

8.0 Priorities for 2019 and 2020

The following outlines priorities for the CSAMP for the 2019 and 2020 calendar years. The priorities focus on projects that will benefit targeted species (Delta Smelt, Chinook salmon and steelhead), support funding for these projects and help make water supplies more reliable, consistent with CSAMP’s adopted purpose statement.

The highest priority for CSAMP will be to support implementation and evaluation of management projects (such as re-operating the Suisun Marsh Salinity Control Gates and using flows in the Yolo Bypass to stimulate the food web) that have the potential to yield valuable information that leads to management actions to improve conditions for targeted species and the reliability of water supply.

CSAMP will also prioritize initiatives such as structured decision making (SDM) and the development of coordinated science plans that advance understanding and inform future decision making.

CSAMP 2019-2020 Priorities are to:

- 1. Complete Current CAMT Investigations and Communicate Findings**
 - a. Factors Affecting Delta Smelt Entrainment (Grimaldo) – complete by Sept 2019
 - b. Delta Smelt Science Plan (Reed) – complete by March 2019
 - c. Characterizing the Relationships between Fall Outflow and Survival and Abundance of Delta Smelt (Fleishman) – complete by October 2019
 - d. Delta Salmon Rearing Habitat Study (SFEI) – complete by September 2019
- 2. Support Implementation of Resiliency Strategies for Delta Smelt and Sacramento Salmonids**
 - a. Assist where CSAMP can add value, including sorting out potential controversy, providing guidance on monitoring, communicating status and results, and assisting where projects are stuck or otherwise need guidance.
- 3. Support Additional Near-term, No Regrets Salmon Actions**
 - a. Identify projects including those in the resiliency strategy where CSAMP could provide science support, funding and project management recommendations for early recovery actions that benefit both listed and non-listed species upriver, and in the Delta, with an emphasis on listed species recovery efforts.
 - b. Evaluate and make recommendations regarding the use of available models to evaluate potential actions.
- 4. Improve Coordination of Salmonid Research in the Delta and Support Development of an Integrated Central Valley Science Plan for Salmonids**
 - a. Conduct Salmon workshop follow-up
 - b. Coordinate with upstream initiatives
 - c. Develop science plan to guide salmon research

5. Initiate Conversation Regarding Oversight, Guidance, and Feedback on Monitoring Schemes Targeting the Delta's Natural Resources

- a. Help establish monitoring designs and protocols necessary to evaluate the effectiveness of management actions
- b. Support efforts to identify indicators of the health and integrity of Delta ecosystems and communities
- c. Discuss CAMT role, if any, in review of long-term fish surveys and sampling schemes to assess status and trends and assess how to maximize the value of dedicated resources.

6. Advance Decision Support Tools

- a. Work towards further engagement in the Delta Science Program SDM process for the Delta.
- b. Further CAMT SDM work on Delta Smelt to prioritize science and management actions.