OUTCOMES

CSAMP Quarterly Policy Group Meeting

Monday, February 13, 2017
Time: 12:00 PM – 3:00 PM
Location: Resources Building, 1416 Ninth Street, Sacramento, Room 1131

The following lists agreements and action items from the February 13, 2017 CSAMT Policy Group meeting.

Agreements

1. Accept CSAMP Purpose document, as edited by PWAs (Attachment A)
2. Accept CSAMP membership recommendation as described in the February 6, 2017 memorandum from Kate Poole, Jason Peltier and Paul Souza (Attachment B)
3. Accept 2017 Workplan for Salmonids as described in the January 23, 2017 memorandum from CAMT (Attachment C).
4. The CSAMP Policy Group will hold a special meeting on March 16, 2017 from 1:00 – 4:00 pm on North Delta salmonid survival and life cycle modeling.
5. New CSAMP initiatives should be guided by an "Executive Sponsor(s)" from the Policy Group to ensure management relevance and assist with securing necessary resources.
6. The CSAMP Policy Group will sponsor Technical Forums on the following topics in 2017:
    a. Summer and Fall Outflow/X2 Management;
    b. Shasta Temperature Management;
    c. Delta Smelt Resiliency Strategy Prioritization and Implementation;
    d. Salmonid Delta Action Plan Prioritization and Implementation.
7. Calendar additional Policy Group meetings to accommodate Technical Forums and other discussions. Quarterly meetings are not enough given the level of activity.

Action Items

1. NMFS to organize presentations on North Delta salmonid survival and life cycle modeling for the March 16, 2017 Policy Group meeting.
2. Co-chairs to work with Policy Group members to identify executive sponsors and leads for the 2017 Technical Forums.
3. DWR to develop estimates of total costs and schedules for each of the 13 Delta Smelt Resiliency Strategy items.
4. CAMT to develop a detailed action plan for implementing the items identified in the 2017 Workplan for Salmonids, including who's doing what, by when, and who's in charge.
5. Bruce to calendar additional Policy Group meetings.

Attachment A

CSAMP Purpose

Collaborative Science and Adaptive Management Program

Purpose

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.

Approach

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. Timely COMPILE AND DISSEMINATE INFORMATION for decision makers on contentious and urgent science issues.

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 ~~be like a spear point on selected~~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.

Scope

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 and technical support, such as the Interagency Ecological Program (IEP), Central Valley Project Improvement Act (CVPIA), NOAA South West Fisheries Science Center (SWFSC), and Delta Science Program (DSP) to avoid duplication, minimize take, and promote collaboration and knowledge transfer.

Attachment B

CSAMP Expansion Memo

February 6, 2017

MEMORANDUM

TO:	CSAMP Policy Group
FROM:	Kate Poole, Jason Peltier, Paul Souza
DATE:	February 6, 2017
RE:	**CSAMP Structure and Expansion**

The CSAMP Policy Group has been asked to consider the addition of new members in connection with reinitiation of consultation (ROC) on the Coordinated Long-term Operation of the Central Valley Project and State Water Project (LTO). While the details of CSAMP's role in the ROC are still being sorted out, we believe it is important to establish a clear, transparent organizational structure for CSAMP as a prerequisite to adding new members. We recommend that the Policy Group consider the following:

1. Group Size – The CSAMP Policy Group should establish a maximum size to maintain efficiency over a defined period of time. The Policy Group currently consists of 14 members (see Attachment 1). We recommend that the Policy Group not exceed 20 members over the next 3 years.
2. Members – Members of the Policy Group serve as representatives of particular interests (see Attachment 1). The current membership includes only one CVP contractor representative and does not include any upstream tributary representatives or in-Delta representatives.
3. Balance – It is important to maintain balanced representation on the Policy Group, including a balance of State and Federal water contractors and NGOs.
4. Non-Member Participation – CSAMP has, and should continue to support participation, particularly at the technical level by diverse interests and experts. Participation in team meetings should be by invitation and should be managed by the CSAMP Program manager in consultation with the CAMT co-chairs.

Proposed Structure and Representation – We recommend that CSAMP retain its current organizational structure (see Attachment 2), but that it add 6 new seats to the Policy Group, 3 to provide additional representation for upstream tributary and in-Delta water contractors and 3 to provide additional NGO representation. The additional water contractor representation could include CVP and/or SWP contractors. This change would result in a balance of 7 water contractor representatives and 7 NGOs on the Policy Group.

Additional background information regarding potential expansion of the CSAMP to assist with ROC is provided in Attachment 3.

ATTACHMENT 1

CSAMP Policy Group

Agency Representatives

Barry Thom..... National Marine Fisheries Service
Bill Croyle..... CA Department of Water Resources
Charlton "Chuck" Bonham..... CA Department of Fish and Wildlife
Felica Marcus..... State Water Resources Control Board
Pablo Arroyave..... U.S. Bureau of Reclamation
Paul Souza.....U.S. Fish and Wildlife Service

NGO Representatives

Dick Pool..... Water4Fish
Gary Bobker ..... The Bay Institute
Jay Ziegler..... The Nature Conservancy
Kate Poole..... Natural Resources Defense Council

Water Contractor Representatives

Bill Phillimore..... Coalition for a Sustainable Delta

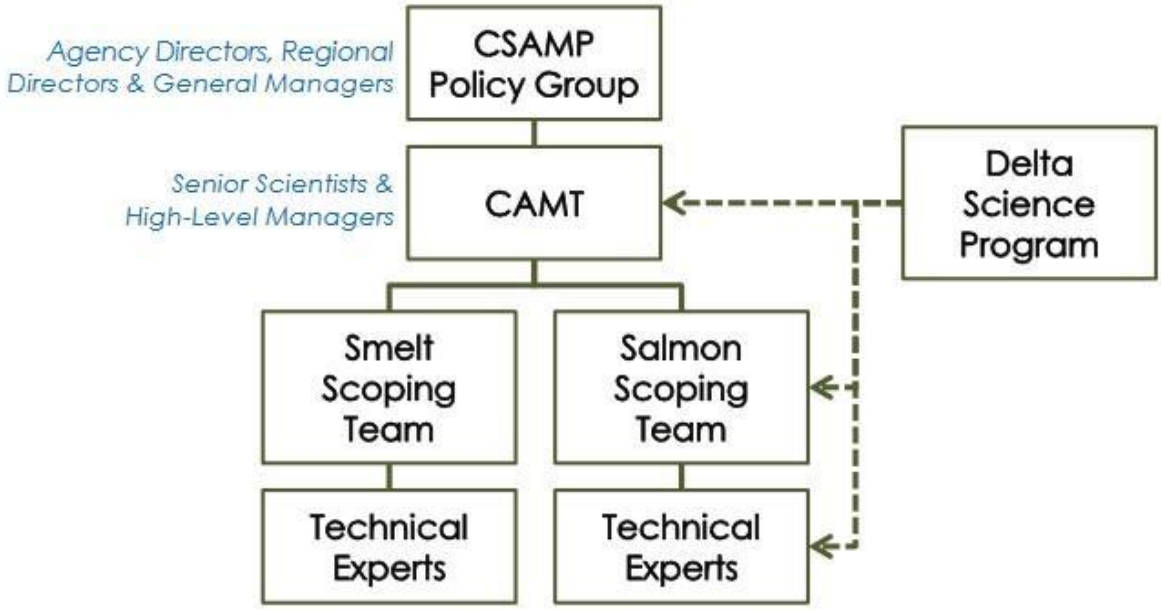
CVP Contractors
Jason Peltier..... San Luis & Delta-Mendota Water Authority

SWP Contractors
Curtis Creel ..... Kern County Water Agency
Jeff Kightlinger..... Metropolitan Water District of Southern CA

ATTACHMENT 2

The Collaborative Science and Adaptive Management Program (CSAMP) is structured as a four-tiered organization comprised of:

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



ATTACHMENT 3

Additional Background Regarding Expansion of the Collaborative Science and Adaptive Management Program (CSAMP) to assist with Reinitiation of Consultation

BACKGROUND

- On August 2, 2016, the Bureau of Reclamation (Reclamation) as the lead Federal agency for Section 7 of the Endangered Species Act, along with the California Department of Water Resources (DWR) as the anticipated applicant, sent letters to U.S. Fish and Wildlife Service[1] (USFWS) and National Marine Fisheries Service[2] (NMFS) requesting the reinitiation of consultation (ROC) on the Coordinated Long-term Operation of the Central Valley Project and State Water Project (LTO).
- In these letters, Reclamation and DWR stated their commitment to an open and transparent process for reviewing the Reasonable and Prudent Alternatives (RPAs) outlined in the 2009 NMFS Biological Opinion (2009 NMFS BO) and the 2008 USFWS Biological Opinion (2008 USFWS BO).
- As part of this transparent process, the letters specifically mentioned the utilization of the CSAMP processes, such as the Collaborative Science and Adaptive Management Team (CAMT), to provide input on various aspects of the reinitiated LTO consultation.
- In response to these reinitiation request letters, NMFS[3] and USFWS[4] provided response letters back to Reclamation that also referred to utilizing the existing CSAMP groups to provide feedback into the LTO reinitiation process.
- Based on the commitments in these four letters, stakeholders from the CVP water contractor community that are currently not represented in CSAMP have come forward to express interest in being engaged as members. The contractors have a vested interest as the ROC on LTO will involve the entirety of the CVP and will not only involve those contractors and interests represented on the existing CSAMP groups.
- The Water Infrastructure Improvements for the Nation Act (WIIN Act), passed in December 2016 by Congress further stipulates in Subtitle J, Sec. 4004 (b) that "[W]hen consultation is ongoing, the Secretaries of the Interior and Commerce shall regularly solicit input from and report their progress to the Collaborative Adaptive Management Team and the Collaborative Science and Adaptive Management Program policy group. The Collaborative Adaptive Management Team and the Collaborative Science and Adaptive Management Program policy

[1] Request for Reinitiation of Section 7 Consultation Addressing Coordinated Long-Term Operation of the CVP and SWP, Letter from Reclamation and DWR to USFWS; http://www.usbr.gov/mp/BayDeltaOffice/docs/reinitiation-letter-to-fws-08022016.pdf

[2] Request for Reinitiation of Section 7 Consultation Addressing Coordinated Long-Term Operation of the CVP and SWP, Letter from Reclamation and DWR to NMFS; http://www.usbr.gov/mp/BayDeltaOffice/docs/reinitiation-letter-to-nmfs-080216.pdf

[3] Reinitiation of OCAP Consultation, NMFS to Reclamation and DWR; http://www.usbr.gov/mp/BayDeltaOffice/docs/nmfs-reponserto-reinitiation-request-08172016.pdf

[4] Response to Request for Reinitiation of Section 7 Consultation Addressing Coordinated Long-Term Operation of the CVP and SWP, Letter from USFWS to Reclamation and DWR; http://www.usbr.gov/mp/BayDeltaOffice/docs/fws-response-to-reinitiation-request-08032016.pdf

group may provide the Secretaries with recommendations to improve the effects analysis and Federal agency determinations. The Secretaries shall give due consideration to the recommendations when developing the Biological Assessment and Biological Opinion." WIIN additionally exempts CAMT and CSAMP from FACA.

- The Secretarial Order (Order 3343) related to California water, signed by Secretary Jewell on January 3, 2017, in Section 4(d)(5) calls for transparent collaborative science, and states that "Reclamation and FWS… will work with independent scientist and stakeholder groups throughout the LTO development process to review scientific information and determine whether physical and biological objectives would be achieved by the proposals under consideration. The scientist and stakeholder groups may include USGS, CSAMP, IEP, or others."
- The currently unrepresented CVP contractors consist of entities that are currently not part of the teams, such as those from the American River Division, the Friant Division and/or the San Joaquin River Exchange Contractors, those located North of Delta (Sacramento River Settlement Contractors and water contractors such as Tehama-Colusa Canal Authority), and those affiliated with the San Joaquin River Tributaries.

RATIONALE AND PURPOSE

- Given the broad direction provided through Congress, the Secretary of the Interior, and the agencies via correspondence on the ROC on LTO, CSAMP groups should be utilized to provide collaborative engagement. This engagement through CSAMP, to be inclusive and fair, needs to include an even and shared representation across the stakeholder community.
- Reclamation and DWR will be required to establish a public outreach and stakeholder inclusion process for the ROC on LTO. Although CSAMP does not replace the public engagement requirements for the ROC, engaging the CVP water contractor community as members would most effectively elevate CSAMP as a forum to discuss and seek resolution on science questions and reduce the need for parallel, duplicative, and potentially conflicting processes that would lack the advantages of the CSAMP discussions.
- The original intent and purpose of CSAMP, as defined in the April 9, 2013 court order, Section 11.B.1.a, is to "*develop a robust science and adaptive management program, with collaboration of the scientists and experts from Public Water Agencies (PWAs) and the NGO community, that will inform the development and implementation of the BiOps, [the Bay Delta Conservation Program ("BDCP")], and other programs*." Additionally, the CAMT was created to develop a robust science and adaptive management program that would inform the implementation of the current BiOps, including interim operations[5], and the development of revised BiOps.
- While the details need further discussion among CSAMP members, the purpose of the expansion could initially be to provide sound scientific recommendations intended to inform the analysis to be undertaken for the ROC on LTO.
- Recommendations from the CSAMP process could be considered for further evaluation and/or inclusion in the alternatives development process required under the National Environmental Policy Act, the Proposed Action in the ROC on LTO Biological Assessment, and/or the resulting Biological Opinions.

[5] "Interim" refers to the period during which revised Biological Opinions were to be developed.

Attachment C

CAMT Salmonid Memo

MEMORANDUM

TO:	CSAMP Policy Group
FROM:	CAMT
DATE:	January 23, 2017
RE:	**2017 Workplan for Salmonids**

The following outlines the proposed CAMT 2017 workplan to address specific science needs and management issues related to juvenile salmonid behavior and survival in the Delta, as discussed with the Policy Group at its November 28, 2016 meeting The workplan is based on findings and recommendations presented in the recent CAMT Salmon Scoping Team (SST) Report (see Attachment A), and other recent salmonid science and management activities in the Delta, including recent State of Bay-Delta Science publications, the IEP SAIL effort, ongoing efforts to improve facility operations, ongoing activities under the CVPIA, and research being conducted by NOAA's Southwest Fisheries Science Center (SWFSC).

Proposed CAMT 2017 Workplan

1. Develop a Salmonid Action Plan for the Delta.

Similar to the recent Delta Smelt Resiliency Strategy, this plan would articulate specific priority, near-term actions to improve salmonid survival in the Delta based on what we know today. The plan would also prioritize actions that provide multi-species benefits. Specific steps in developing the plan would include:

a. Develop/review biological objectives for juvenile survival in, and through the Delta.,

b. Inventory and review the status of ongoing actions and research associated with facility operations, including what has been collected, what needs to be analyzed, and what is needed to help fill gaps and inform further actions.

Actions to review should include, but not be limited to:

- Preferential operation of the CVP;
- Predator studies and control actions in Clifton Court Forebay and the Jones Pumping plant; and
- Improvements to salvage operations.
- Improvements at the cross channel gates and at Georgiana Slough

Specific questions to examine would include:

- Are the actions being implemented?
- Are they fully funded?
- Are there monitoring and evaluation efforts in place?
- What are the key measures (performance measures) and metrics that will be used to determine if this action is effective?
- Can the actions be accelerated?

c. Based on biological objectives and the review of ongoing actions, identify targeted research and additional science-based actions to pursue through an adaptive management framework.

Actions could include, but should not be limited to:

- Formulating operational experiments to address a broader range of export conditions that would address data gaps identified by in the SST report (e.g. high export/low inflow and low export/high inflow);
- Conducting additional desk-top analyses of CWT and AT data, including assessment of the full 6 years of steelhead data to evaluate the effectiveness of I:E ratios, whether an alternative metric may be more appropriate, and what additional experimental conditions may be needed to further narrow uncertainties;
- Addressing predation outside the facilities (e.g. experimental predation control at key "hot spot" locations in the Delta and/or modification of habitat to reduce predation at specific locations); and
- Evaluating and enhancing rearing conditions in the Delta (e.g. improved habitat within the Delta).

2. Follow up on Key Data Gaps Identified by the SST to Address Management Questions, Improve Decision Support Models and Support Development of Additional Actions to Improve Survival.

The SST report indicates that the mechanisms effecting migration behavior and survival in the South Delta, and how they may be affected by project operations are not well understood. In addition, the SST report identified significant uncertainties related to the specific management questions focused on the existing RPAs. The South Delta Research Collaborative also recommended focused research designed to reduce uncertainties and inform future management. Recommended activities for 2017 are:

a. Identify key management questions to direct areas for targeted model development, desktop analyses and research.
b. Evaluate SAIL recommendations in the context of the more comprehensive research and monitoring plan recommended by the SST to sddress key management questions.
c. Work with the CVPIA Program to improve existing CVPIA modeling and decision support tools, and implement actions to improve salmonid survival in the Delta.
d. Develop a management-driven RFP to address management questions, including conduct of targeted modeling, desktop analyses and research.

Attachment A
Summary of Findings from the SST Report

The SST Report highlights several findings that we found particularly important in understanding the current state of knowledge and in developing management recommendations. These findings are briefly listed below. For more details on each, we refer the reader to the full report.

1. Project Effects and Current Management Actions- CAMT requested that the SST respond to eight specific management questions associated with the effects of water project operations and the effectiveness of current management actions, including reasonable and prudent alternative (RPA) actions intended to protect salmonids. Several key responses are provided below. Detailed responses to each question can be found in Volume 2 of the SST Report.
    - Survival varies among reaches and between species. Some reaches of the Delta indicate very poor survival in almost all years tested (Figure 2 and Tables 1, 2; reach designations are shown in Figure 1). Although the available data on route-specific survival in the south Delta are currently limited to partial data for five years for juvenile Chinook salmon and only two years for juvenile steelhead, survival of juvenile Chinook salmon entering the Turner Cut route, for example, was 0% for all available release groups in 2008, 2011 and 2012 (Table 1).
    - Export effects on hydrodynamic conditions in the Delta channels (water velocity and flow direction) vary with distance from the export facilities, export level, inflow, and tides.
    - The SST Report recommends that further refinement of hydrodynamic models be done prior to their integration with the responses of acoustic tagged juvenile salmon and steelhead to establish a stronger basis for predicting the effects of changes in velocity and flow on salmonids during migration through the Delta.
    - Results of studies show that route selection is generally proportional to the flow split at channel junctions, and the effect of exports on route selection is strongest at the junction leading directly to the export facilities.
    - Within the South Delta, exports typically have the strongest effect on the net magnitude and direction of flow and velocity in Old River immediately adjacent to the export facilities and in Middle River at Victoria Canal and the downstream end of Railroad Cut and at Columbia Cut. Changes in flow and velocity also occur as a result of export operations at the Head of Old River.
    - The evidence of a relationship between exports and through-Delta survival is inconclusive (SST Vol. 1 Appendix E). Results of juvenile Chinook salmon survival studies using CWT and more recently (2007-2012) acoustic tags have not shown a strong or consistent relationship with SWP and CVP export rates. Steelhead data are more limited currently to only 2011 and 2012, which are insufficient to support an analysis of the potential relationship between export rate and survival. Additional data through 2016 is being analyzed for both salmon and steelhead. Survival rates for juvenile salmon since 2002 have been consistently low independent of variation in both export rates and Delta inflows. It is unknown whether equivocal findings regarding the existence and nature of a relationship between exports and through-Delta survival is due to the lack of a relationship, the concurrent and confounding influence of other variables, or the effect of low overall survival in recent years. Comparisons of survival to export rates are complicated by the high correlation between inflow and exports and by the sparse data available for higher export rates (SST Report, page E.6-83). These findings support a recommendation for analysis of available data as

well as additional investigations to test hypotheses regarding export effects on migration and survival of Sacramento and San Joaquin River origin salmonids migrating through the Delta.

- Analysis of additional acoustic tag data for 2013 – 2016 will help further assess potential relationships for both salmon and steelhead. The incremental contribution of water project operations on the total mortality of juvenile salmonids has not been quantified. Many of the mechanisms through which changes in Delta hydrodynamics and other factors related to water project operations may contribute to salmonid mortality (e.g., a change in vulnerability to predation in Delta channels as a result of water project operations) are uncertain. Indirect losses associated with water project operations, such as changes in local Delta hydrodynamic flows and velocities or gate operations, that result in route selection into areas with increased mortality, delays or extended migration duration that increase potential exposure to predators and other sources of mortality, or changes in physical habitat conditions such as channelization and riprap that reduce cover and increase exposure to predation, have not been quantified and their incremental contribution to total mortality in the Delta under varying water project operations and other environmental conditions remain uncertain;
- There is evidence of a positive relationship between inflow and survival in some portions of the Delta based on acoustic tag data; survival from Mossdale to Turner Cut tends to be higher for higher levels of inflow, while survival from Turner Cut to Chipps Island tends to be lower and related to exports. A positive relationship has been found between flow and CWT survival between Mossdale and Durham Ferry to Jersey Point with the Head of Old River Barrier in place.
- In addition, there is a positive relationship between April-May I:E and through-Delta survival with the Head of Old River Barrier (HORB) in place; survival from Mossdale to the Turner Cut junction tends to increase for higher I:E values. The extent to which management actions such as reduced Old and Middle River (OMR) flows, San Joaquin River I:E ratio, and Delta E:I ratio affect through-Delta survival is uncertain due to limited testing and ability to establish some test conditions. Determining the effectiveness of these management operations is difficult when all observations are in the presence of those restrictions. To better understand these relationships targeted, well designed experiments under controlled conditions may be required. The experimental design of future survival studies should consider prescribing specific levels of inflows and exports, including those at the high and low ends of the range, in an effort to improve the opportunities for detecting biological response to these management variables, if they occur.
- High correlation between inflow and exports limits the ability to evaluate survival effects over a range of I:E ratios and the same I:E ratio may represent very different magnitudes of inflow and exports which further confounds the analysis of potential relationships with migration rate, route selection, and survival.
- There is uncertainty in the spatial and temporal variability in stressors to salmonids in the Delta and how those stressors respond to water project operations and other physical and environmental factors.
- The January 1 onset of OMR flow management coincides with the presence of winter-run Chinook salmon in most years, spring-run Chinook salmon in many years, and steelhead in some years. If OMR management were initiated based on first detection in the Delta rather than a fixed date, OMR management would often begin earlier than January 1.
- Salvage data indicate that juvenile Chinook salmon densities at the export facilities are greater during periods of more negative OMR flows, therefore, density-based export

restrictions likely reduce take. However, survival studies conducted to date have not been designed to measure route-specific survival at a scale that could resolve how survival along interior channels of the South Delta changes within the specific range of hydrodynamic changes governed by density-based export restrictions (e.g. OMR changes between -2,500 and -5,000 cfs). Currently no analyses have been performed to assess the relationship between OMR and juvenile salmonid migration or survival or the biological benefits associated with either implementation of the January 1 trigger or the density based trigger for managing OMR.

Findings presented in the SST report regarding ongoing management actions suggest that more robust, multi-factor analyses and additional mechanistic studies will be needed to more accurately assess the mechanistic basis for how environmental factors and management actions may influence behavior, routing, predation, habitat, and survival within Delta channels.

An example of changes in water velocities as a function of Delta inflow and exports is shown in Figure 1 based on DSM2 Hydro simulation modeling (Figure 3-2 from the SST Report Vol. 1). Reach-specific survival rates were estimated based on available acoustic tag study results for juvenile Chinook salmon (5 years of data) and for juvenile steelhead (2 years of data). The general geographic reaches are shown in Figure 2 as an example of survival from one year of the juvenile Chinook salmon releases (the illustration in Figure 2 is based on acoustic tag results for juvenile Chinook salmon in 2011 as shown in Tables 1 and 2). Tables 1 and 2 summarize all of the available reach-specific survival or the transition probabilities for both Chinook salmon and steelhead.

2. Salmonid Survival in the Delta is Persistently Low – The available data show that juvenile fall-run Chinook survival in the lower San Joaquin River and Delta has been low and declining for some time and has been less than 5% for 14 of 22 estimates and less than 10% for 20 of 22 estimates since 2002 (Figure 3). Survival in the south Delta has been low for all migration routes since implementation of acoustic tagging in 2008. Since 2002, survival has been low (less than 20%) even in higher flow years (2006, 2011). Survival of juvenile steelhead in the south Delta (32 and 54% in 2011 and 2012) has been higher than for fall-run Chinook salmon (2 and 3%) in the same years.

3. The Delta is a Highly Variable and Complex Environment – Environmental conditions in the Delta vary considerably in space and time. The effects of this variability can have profound impacts on fish behavior and our ability to predict and manage that behavior. Portions of the Delta are dominated by riverine conditions, while other portions are strongly influenced by tidal action. These areas also change over time (daily, seasonally, and annually) depending on inflows and tidal cycles. Conditions are further complicated by complex channel junctures and the fact that juvenile salmonids can exhibit many different types of behavior depending on life stage (fry versus smolt) and whether they are rearing or migrating. Management actions, such as maintaining a set inflow/export ratio can have very different effects in different parts of the Delta. This suggests that we may need different solutions for different regions of the Delta.

4. Larger Fish Usually Exhibit Better Survival – The survival of larger juvenile salmonids through the Delta is usually higher than smaller fish. This finding suggests that efforts to improve rearing conditions upstream, and potentially in the Delta, could improve overall survival

through the Delta. Though not included in the SST report, the recent State of Bay Delta Science journal article on salmonids (Perry et. al. 2016) indicated that life history diversity also matters, and it appears that significant numbers of fry may use the Delta to rear and fry may contribute substantially to adult returns in certain years.

5. Information is Lacking Regarding Thresholds of Effects – While a few actions have been taken to reduce salmonid mortality in the Delta, our understanding of various thresholds is limited. This includes biological thresholds such as changes in instantaneous velocities that trigger changes in fish behavior as well as management thresholds such as the change in survival that would need to occur in order for us to detect a difference or expect an effect at a population level. Similarly, we have not established specific goals and objectives that would allow us to design actions to achieve such responses, to assess performance over time to determine when an action has been successful, either at an individual survival level or a population level, or to modify or abandon the action if it is not achieving the desired response.

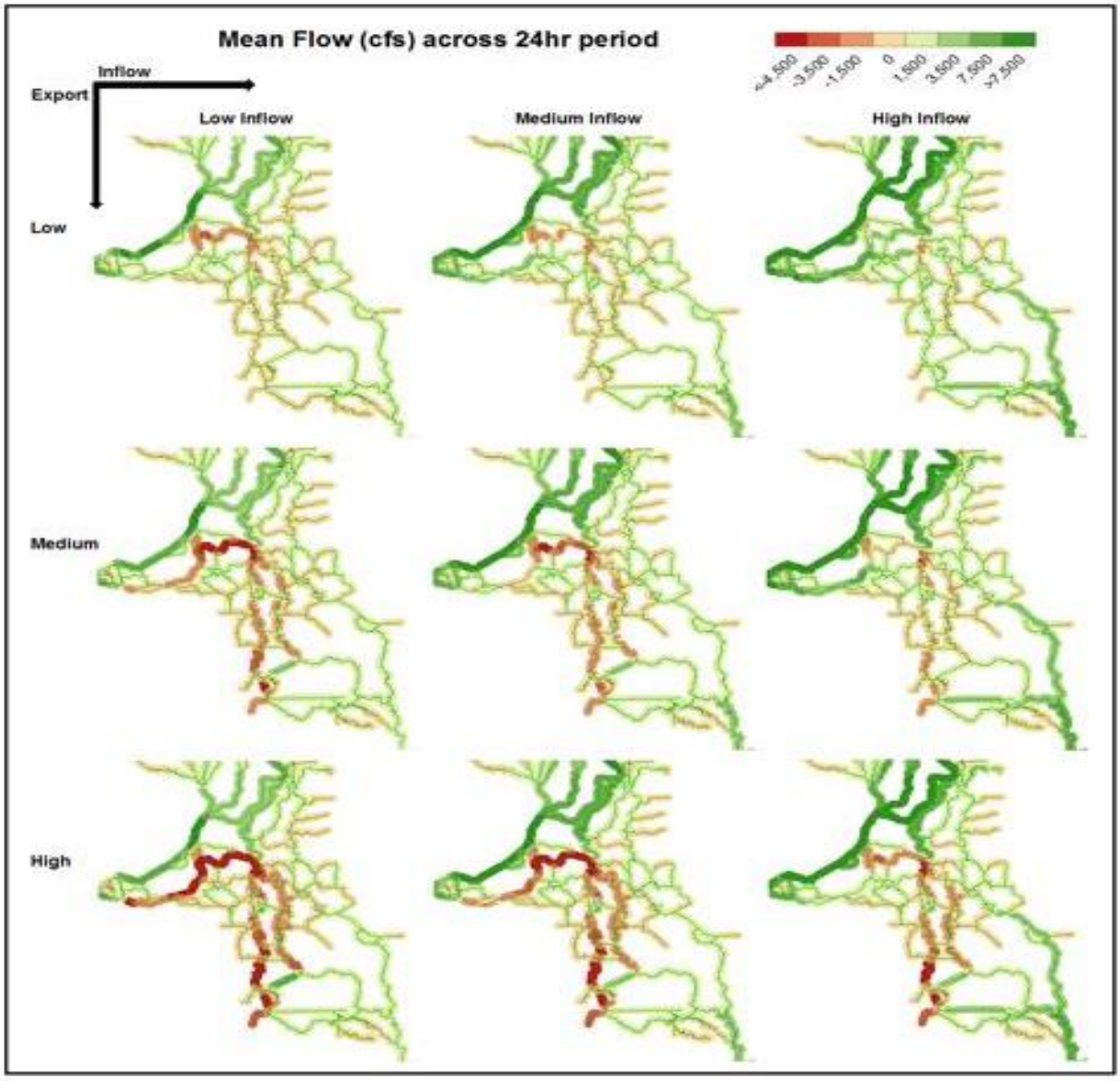


Figure 1. Daily average flow at each DSM2 channel at three export rates and three Delta inflow rates (Source: Figure 3-2 Vol. 1 SST Report).

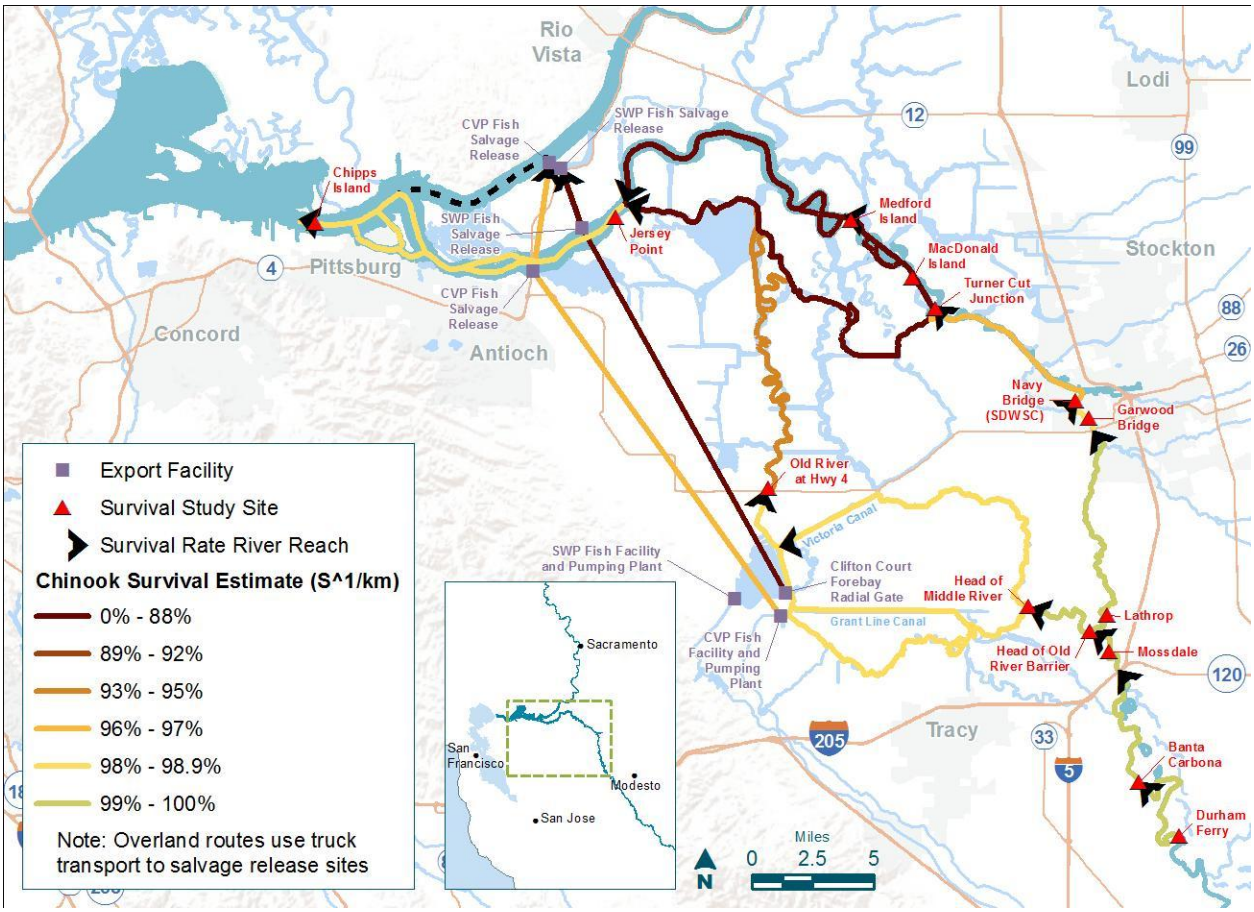


Figure 2. Geographical illustration of heat map survival rate (per km) estimates for 2011 Chinook salmon.

Note: See **Error! Reference source not found.***and* **Error! Reference source not found.** *for complete results from all years and species.*

Table 1. Heat Map Depicting Survival Rates ($S^{(1/km)}$) through San Joaquin River Reaches to Chipps Island.

Reach Name (km)	Survival estimate per km ($S^{(1/km)}$)						
	Chinook					Steelhead	
	2008	2009	2010	2011	2012	2011	2012
Durham Ferry (Release) to Banta Carbona; (11)			0.999	0.994	0.975	0.962	0.967
Banta Carbona to Mossdale; (10/9)			0.995	0.993	0.953	0.982	0.978
Mossdale to Head of Old River; (4/5)	0.967	0.954	0.981	0.997	0.987	0.985	0.995
Lathrop to SJR at Garwood Bridge; (18/15)	0.986	0.971	0.989	0.993	0.980	0.995	0.997
Garwood Bridge to SDWSC; (3)	0.955	0.921	0.983	0.980	0.936	0.993	0.990
SDWSC to Turner Cut junction; (15)	0.958	0.852	0.942	0.965	0.947	0.997	0.994
MacDonald Island to Medford Island; (5)			0.863	0.833	0.852	0.942	0.923
Turner Cut to Jersey Point (includes Interior Delta route but not SJR); (28)	0			0	0	0.958	0.934
Medford Island to Jersey Point; (21)				0.881	0.964	0.992	0.987
Jersey Point to Chipps Island; (22)	0.981			0.983	0.971	0.997	0.989

Note: Red Boxes Indicate Lowest Survival Rate (less than 0.90 per km) and Lighter Boxes Indicate Higher Survival Rate (white: ≥0.99 per km). Missing values reflect too few fish present in the reach to estimate survival, or study was not designed to estimate parameter.

Table 2. Heat Map Depicting Survival Rates ($S^{(1/km)}$) through Old River Reaches to Chipps Island.

Reach Name/(km)	Survival estimate per km ($S^{(1/km)}$)						
	Chinook					Steelhead	
	2008	2009	2010	2011	2012	2011	2012
Old River (head) to Middle River Head; (6)		0.953	0.983	0.997	0.981	0.990	0.977
Middle River Head to CVP/CCF/HWY 4; (20/21)		0.912	0.997	0.981		0.994	0.977
Old River near HWY 4 to Jersey Point; (60)			0.926	0.936		0.992	0.958
CVP tank to Chipps Island; (15/19)	0.845		0.972	0.969		0.988	0.973
CCF Radial Gates (interior) to Chipps Island; (21/24)	0.904		0	0.83		0.979	0.924

Note: Red Boxes Indicate Lowest Survival Rate (less than 0.90 per km) and Lighter Boxes Indicate Higher Survival Rate (white: ≥0.99 per km). Missing values reflect too few fish present in the reach to estimate survival, or study was not designed to estimate parameter.

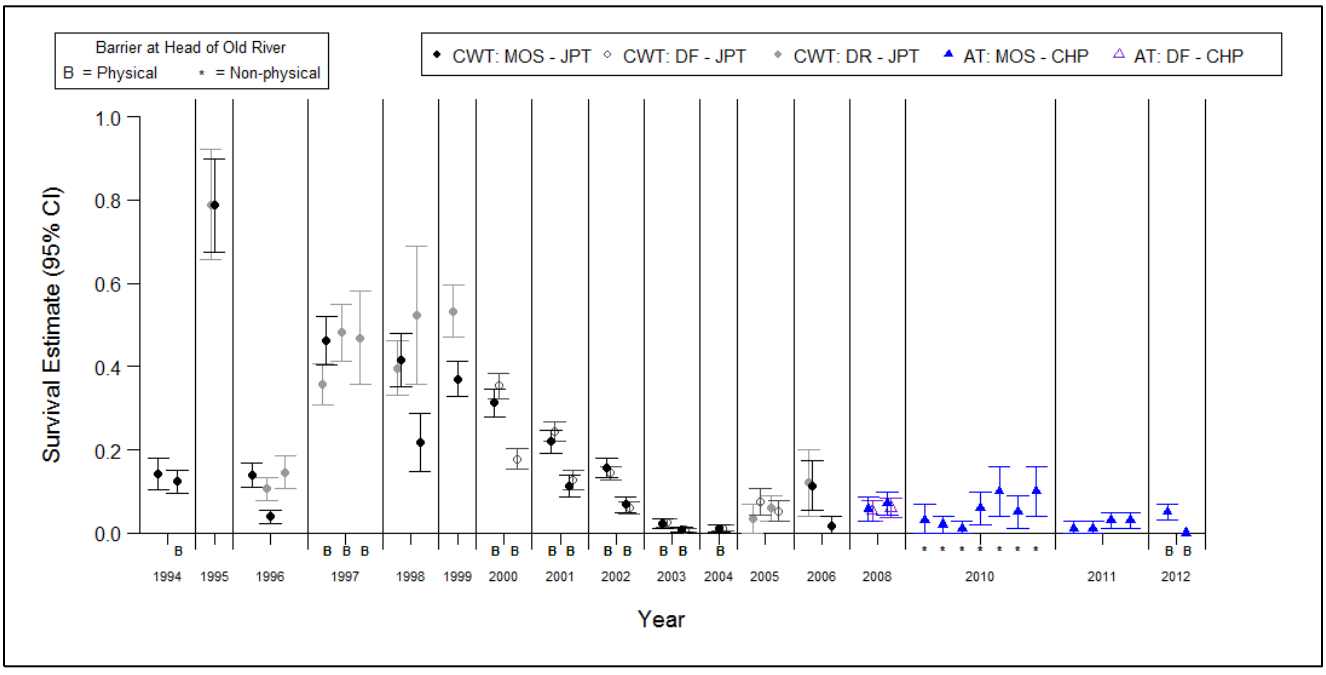


Figure 3. Estimated survival of Fall-run Juvenile Chinook Salmon from Mossdale (MOS), Durham Ferry (DF), or Dos Reis (DR) to either Jersey Point (JPT; CWT) or Chipps Island (CHP; AT). Intervals are 95% confidence intervals, truncated to 0 if necessary.

Source: SJRGA 2013, Buchanan et al. 2015