MEMORANDUM

TO: SLDMWA Water Resources Committee Members and Alternates

FROM: Scott Petersen, Water Policy Director

DATE: July 11, 2022

RE: Update on Water Policy/Resources Activities

BACKGROUND

This memorandum is provided to briefly summarize the current status of various agency processes regarding water policy activities, including but not limited to the (1) Reinitiation of Consultation on Long-Term Operations of the Central Valley Project and State Water Project, including environmental compliance; (2) State Water Resources Control Board action; (3) San Joaquin River Restoration Program; (4) Delta conveyance; (5) Reclamation action; (6) Delta Stewardship Council action; (7) San Joaquin Valley Water Blueprint and San Joaquin Valley Water Collaborative Action Plan.

POLICY ITEMS

Reinitiation of Consultation on Long-Term Operations of the Central Valley Project and State Water Project

In August 2016, the Bureau of Reclamation and California Department of Water Resources (DWR) requested reinitiation of consultation with NOAA Fisheries, also known as National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) due to multiple years of drought, low populations of listed species, and new information developed as a result of ongoing collaborative science efforts over the last 10 years.

On Jan. 31, 2019, Reclamation transmitted its Biological Assessment to the Services. The purpose of this action is to continue the coordinated long-term operation of the CVP and SWP to optimize water supply delivery and power generation consistent with applicable laws, contractual obligations, and agreements; and to increase operational flexibility by focusing on nonoperational measures to avoid significant adverse effects to species.

The biological opinions carefully evaluated the impact of the proposed CVP and SWP water operations on imperiled species such as salmon, steelhead and Delta smelt. FWS and NMFS documented impacts and worked closely with Reclamation to modify its proposed operations to minimize and offset those impacts, with the goals of providing water supply for project users and protecting the environment.

Both FWS and NMFS concluded that Reclamation's proposed operations will not jeopardize threatened or endangered species or adversely modify their critical habitat. These conclusions were reached for several reasons – most notably because of significant investments by many partners in science, habitat restoration, conservation facilities including hatcheries, as well as protective measures built into Reclamation's and DWR's proposed operations.

On Oct. 21, 2019, FWS and NMFS released their biological opinions on Reclamation's and DWR's new proposed coordinated operations of the CVP and SWP.

On Dec. 19, 2019, Reclamation released the final Environmental Impact Statement analyzing potential effects associated with long-term water operations for the CVP and SWP.

On Feb. 18, 2020, Reclamation approved a Record of Decision that completes its environmental review for the long-term water operations for the CVP and SWP, which incorporates new science to optimize water deliveries and power production while protecting endangered species and their critical habitats.

On January 20, 2021, President Biden signed an Executive Order: "Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis", with a fact sheet[1] attached that included a non-exclusive list of agency actions that heads of the relevant agencies will review in accordance with the Executive Order. Importantly, the NOAA Fisheries and U.S. Fish and Wildlife Service Biological Opinions on the Long-Term Operation of the Central Valley Project and State Water Project were both included in the list of agency actions for review. It's unclear what this agency review will analyze, but staff will be engaged.

On September 30, 2021, Reclamation Regional Director Ernest Conant sent a letter to U.S. FWS Regional Director Paul Souza and NMFS Regional Administrator Barry Thom requesting reinitiation of consultation on the Long-Term Operation of the CVP and SWP. Pursuant to 50 CFR § 402.16, Reclamation indicated that reinitiation is warranted based on anticipated modifications to the Proposed Action that may cause effects to listed species or designated critical habitats not analyzed in the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions, dated October 21, 2019. To address the review of agency actions required by Executive Order 13990 and to voluntarily reconcile CVP operating criteria with operational requirements of the SWP under the California Endangered Species Act, Reclamation and DWR indicated that they anticipate a modified Proposed Action and associated biological effects analysis that would result in new Biological Opinions for the CVP and SWP.

Following this action, on October 20, 2021, the SLDMWA sent a letter to Reclamation Regional Director Ernest Conant requesting participation in the reinitiation of consultation pursuant to Section 4004 of the WIIN Act and in the NEPA process as either a Cooperating Agency or Participating Agency.

[1] https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/20/fact-sheet-list-of-agency-actions-for-review/

On February 26, 2022, the Department of the Interior released a Notice of Intent To Prepare an Environmental Impact Statement (EIS) and Hold Public Scoping Meetings on the 2021 Endangered Species Act Reinitiation of Section 7 Consultation on the Long-Term Operation of the Central Valley Project and State Water Project[2]. In response to this, on March 30, 2022, the SLDMWA submitted a comment letter highlighting actions for Reclamation to consider during preparation of the EIS.

Last month, Reclamation issued draft copies of the Knowledge Base Papers for the following management topics:

1. Spring-run Juvenile Production Estimate- Spring-run Survival Knowledge Base Document, May 2022
2. Steelhead Juvenile Production Estimate-Steelhead Survival Knowledge Base Document, April 2022
3. Old and Middle River Reverse Flow Management – Smelt, Chinook Salmon, and Steelhead Migration and Survival Knowledge Base Document, May 2022
4. Central Valley Tributary Habitat Restoration Effects on Salmonid Growth and Survival Knowledge Based Paper, March 2022
5. Delta Spring Outflow Management Smelt Growth and Survival Knowledge Base Document, May 2022
6. Pulse Flow Effects on Salmonid Survival Knowledge Base Document, May 2022
7. Summer and Fall Habitat Management Actions – Smelt Growth and Survival Knowledge Base Document, May 2022
8. Shasta Cold Water Pool Management – End of September Storage Knowledge Base Document, May 2022

The Authority provided supplementary material and scientific citations[3] for Reclamation's consideration during finalization of the Knowledge Base Papers.

Current Milestones

- Virtual Scoping and a Scoping Report (2022)
- Initial Alternatives and Knowledge Base Papers (2022)
- Final Alternatives and Proposed Action (2022)
- Biological Assessment and Public Draft EIS (2023)
- Final EIS (2024)
- Record of Decision (2024)

Exploratory Modeling

Concurrent with the development of the EIS and BA, Reclamation is conducting Exploratory Modeling to assist in the development of initial alternatives for the Biological Assessment. Recent

[2] https://www.govinfo.gov/content/pkg/FR-2022-02-28/pdf/2022-04160.pdf
[3] See Appendix

discussions have involved updates to the 2021 LTO Climate Change Methodology, the Delta Zone of Influence Analysis and the Shasta Operations Analysis.

Climate Change Analysis

The exploratory modeling efforts for the LTO Climate Change proposes future climate conditions centered on 2040, with analyses mainly based on the median climate change scenario, and sensitivity scenarios to review the range of modeling uncertainty, including:

- Hot and dry
- Warm and wet
- Extreme heat and dryness
- Warm and dry, and
- Hot and wet

Reclamation Manual

Documents out for Comment

Draft Policy

- SLE P08 Emergency Management (comments by 7/24/2022)

Draft Directives and Standards

- ADM 04-01 Planning, Approval, and Reporting Conference Related Activities for Spending (comments by 7/15/2022)

Draft Facilities Instructions, Standards, and Techniques (FIST)

- There are currently no Facilities Instructions, Standards, and Techniques out for review.

Draft Reclamation Safety and Health Standards (RSHS)

- RSHS 20 Mobile and Stationary Mechanized Equipment (comments by 7/15/2022)

Draft Reclamation Design Standards

- There are currently no Design Standards out for review.

State Water Resources Control Board (State Water Board) Activity

Curtailment Update

On June 28, the State Water Board issued an update about the curtailment status of water rights and claims of right within the Sacramento-San Joaquin Delta (Delta) watershed pursuant to Initial Orders Imposing Water Right Curtailment and Reporting Requirements in the Delta Watershed (Order for water rights/claims under 5,000 acre-feet and Order for water rights/claims over 5,000 acre-feet).

The following water rights are curtailed, effective June 29, 2022, unless and until the State Water Board advises that this determination has been updated:

1. Water rights on the following Sacramento River tributaries:
    a. Post-1914 appropriative water rights in the Bear River subwatershed with a priority date of 1942 or later; and

   b. Post-1914 appropriative water rights in the Putah Creek subwatershed outside of the Legal Delta with a priority date of 1945 or later.

2. Water rights and claims on the following San Joaquin River tributaries:
   a. All post-1914 appropriative water rights, pre-1914 appropriative water right claims, and riparian water right claims in the Calaveras River subwatershed outside of the Legal Delta;
   b. All post-1914 appropriative water rights, pre-1914 appropriative water right claims, and riparian water right claims in the Chowchilla River subwatershed; and
   c. Post-1914 appropriative water rights and pre-1914 appropriative water right claims in the Merced River subwatershed with a priority date of 1859 or later.

3. Post-1914 appropriative water rights and pre-1914 appropriative water right claims in the San Joaquin River watershed outside of the Legal Delta with a priority date of 1914 or later.

Curtailments are expected to continue through the summer and early fall until significant precipitation occurs. Water supply forecasts will continue to be evaluated regularly to determine if, when, and to what extent the further re-imposition or suspension of curtailments may be appropriate. The next curtailment status update will be provided by email and web posting no later than July 6, 2022. Please check the Delta Watershed Curtailment Status List for the current curtailment status of each water right and claim in the Delta watershed.

The above curtailments consider the following technical and policy inputs to the Water Unavailability Methodology for the Delta Watershed (methodology):

1. **Curtailments based on the subwatershed-scale analyses.** Curtailments account for both local water unavailability in headwater subwatersheds and watershed-wide conditions.
2. **Modification of demands for water rights and claims associated with contractual agreements with the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources.** Sacramento River Settlement Contractor and Feather River Contractor demands were reduced compared to 2018 data, consistent with contractual agreements applicable this year. San Joaquin River Exchange Contractor (SJREC) demands for June were adjusted to account for demands for San Joaquin River water due to reduced deliveries of water from the Delta provided by Reclamation.
3. **Legal Delta.** Current analyses do not support curtailments in the Legal Delta. Term 91 curtailments will continue to apply to rights within and outside the Legal Delta containing Term 91.

The above curtailments factor in estimated agricultural and municipal return flows based on CalSim 3 results for 1976 and reduced demands associated with Central Valley Project and State Water Project exports from the Delta under the State Water Board's April 4, 2022 Order

Approving Temporary Urgency Changes to Water Right License and Permit Terms Relating to Delta Water Quality.

This curtailment status update is based on the output of the methodology for the calendar month of June. As such, today's update considers observed water supply data and forecasts from the California Nevada River Forecast Center (CNRFC) that were updated on June 28, 2022. The 50% exceedance water supply forecast was selected to determine curtailments at this time. Other than modifications identified above, demand data informing curtailments continue to be based on reported diversions from 2018.

The determination of water unavailability used to inform curtailments is based on the Water Unavailability Methodology for the Delta Watershed.

Water Unavailability Methodology and Revised Draft Emergency Curtailment Regulation

Background

On August 3, 2021, the State Water Board adopted an emergency regulation authorizing the curtailment of diversions when water is determined to be unavailable at a water right holder's or claimant's priority of right. (Cal. Code Regs., tit. 23, §§ 876– 879.2.) The regulation was approved by the Office of Administrative Law and went into effect upon filing with the Secretary of State on August 19, 2021. The emergency regulation remains in effect for up to one year. The State Water Board plans to consider revision and re-adoption of this emergency regulation on July 20, 2022, in advance of the expiration date of the current regulation.

On April 19, 2022, the State Water Board released draft proposed revisions to the emergency regulation and methodology revisions and solicited public input on both in writing by May 19, 2022, and orally at a public workshop on May 12, 2022. Based on those comments, updates to the methodology and draft emergency regulation were developed. The current version of the Draft Emergency Curtailment and Reporting Regulation has been released for further public review and comment in advance of the July 20, 2022 Board Meeting, at which the Board will consider re-adoption of the emergency regulation, as revised. The latest proposed emergency regulation includes sections applicable to multiple watersheds in the state, including the Delta, that were revised by the Board in May during the re-adoption of the emergency regulation for the Russian River watershed. The latest proposed regulation would continue to require water right holders in the Delta watershed to curtail their diversions when the State Water Board determines, based on the methodology and the best information available to the Board, that water is not available to serve their priority of right. The emergency regulation would also continue to allow limited exceptions to curtailment for specified uses such as meeting minimum human health and safety needs and to allow the Board to require that water right holders provide additional information related to their water diversion and use.

In addition to the emergency regulation noted above, a June 27, 2022 updated Water Unavailability Methodology has also been posted. The April 19, 2022 version of the methodology did not include updates to Technical Appendix D. The June 27, 2022 version of the methodology includes updates to Appendix D. The State Water Board is not soliciting comments on other

aspects of the methodology that have already been considered during the prior public comment process.

The deadline for written comments concerning this matter is 12:00 noon on Friday, July 8, 2022. Comments submitted are for the July 20, 2022, Board Meeting, during which the Board will consider revision and re-adoption of the emergency regulation.

If re-adopted by the State Water Board, the emergency regulation will be submitted to the Office of Administrative Law for a public comment period, review, and requested approval. If approved, the re-adopted emergency regulation would become effective upon filing with the Secretary of State, anticipated by mid-August of 2022 and in advance of expiration of the current emergency regulation. If re-adopted and approved, the emergency regulation would remain in effect for up to one year but could be repealed if hydrologic conditions improve, or re-adopted again if drought conditions persist.

Bay Delta Water Quality Control Plan Update

The State Water Board is currently considering updates to its 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary ("Bay Delta Plan") in two phases (Plan amendments). The first Plan amendment is focused on San Joaquin River flows and southern Delta salinity ("Phase I" or "San Joaquin River Flows and Southern Delta Salinity Plan Amendment"). The second Plan amendment is focused on the Sacramento River and its tributaries, Delta eastside tributaries (including the Calaveras, Cosumnes, and Mokelumne rivers), Delta outflows, and interior Delta flows ("Phase II" or "Sacramento/Delta Plan Amendment").

During the December 12, 2018 Water Board Meeting, the Department of Water Resources ("DWR") and Department of Fish and Wildlife presented proposed "Voluntary Settlement Agreements" ("VSAs") on behalf of Reclamation, DWR, and the public water agencies they serve to resolve conflicts over proposed amendments to the Bay-Delta Plan update.[4] The State Water Board did not adopt the proposed VSAs in lieu of the proposed Phase 1 amendments, but as explained below, directed staff to consider the proposals as part of a future Delta-wide proposal.

Phase 1 Status: The State Water Board adopted a resolution[5] to adopt amendments to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary and adopt the Final Substitute Environmental Document during its December 12, 2018 public meeting.

Phase 2 Status: In the State Water Board's resolution adopting the Phase 1 amendments, the Water Board directed staff to assist the Natural Resources Agency in completing a Delta watershed-wide agreement, including potential flow and non-flow measures for the Tuolumne River, and associated analyses no later than March 1, 2019. Staff were directed to incorporate

[4] Available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Blogs/Voluntary-Settlement-Agreement-Meeting-Materials-Dec-12-2018-DWR-CDFW-CNRA.pdf.

[5] Available at https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2018/rs2018_0059.pdf.

the Delta watershed-wide agreement as an alternative for a future, comprehensive Bay-Delta Plan update that addresses the reasonable protection of beneficial uses across the Delta watershed, with the goal that comprehensive amendments may be presented to the State Water Board for consideration as early as possible after December 1, 2019. As the State Water Board further refines this update, there will be opportunity for public comment.

The effort has made progress since an initial framework was presented to the State Water Board on December 12, 2018.

On March 1, 2019, the California Department of Water Resources and the Department of Fish and Wildlife submitted documents[6] to the State Water Board that reflect progress since December to flesh-out the previously submitted framework to improve conditions for fish through targeted river flows and a suite of habitat-enhancing projects including floodplain inundation and physical improvement of spawning and rearing areas.

Since the March 1 submittal, work has taken place to develop the package into a form that is able to be analyzed by State Water Board staff for legal and technical adequacy. On June 30, 2019, a status update with additional details was submitted to the Board for review. Additionally, on February 4, 2020, the State team released a framework for the Voluntary Agreements to reach "adequacy", as defined by the State team.

Further work and analysis is needed to determine whether the agreements can meet environmental objectives required by law and identified in the State Water Board's update to the Bay-Delta Water Quality Control Plan.

On December 8, the State Water Resources Control Board heard an information item on upcoming actions to update and implement the Water Quality Control Plan for the San Francisco Bay Sacramento San Joaquin Delta.

Schedule

Biological Goals

Past Activities

- January 2019 – Independent Science Advisory Panel: Concepts and Ideas for Developing Biological Goals for the Bay-Delta Plan
- September 2019 – Draft Initial Biological Goals for the LSJR for public comment

Current Activities

- Completion of revisions based on public comment to produce a draft Final Biological Goals Report

Future Activities

- Winter/Spring 2022 – Release draft Final Biological Goals Report
- Winter/Spring 2022 – Public Workshop & comment

[6] Available at http://resources.ca.gov/docs/voluntary-agreements/2019/Complete_March_1_VA_Submission_to_SWRCB.pdf

- Summer 2022 – Board consideration of adoption

LSJR Flow/SD Salinity Implementation Next Steps Assuming Regulation Path (Phase 1)

Spring 2022 – Spring 2023

- Initiate CEQA process
- Draft environmental document and public comment
- Notice of draft regulation
- Final environmental document

Summer 2023

- State Water Board consideration of approval
- Notice of final regulation
- Submission to Office of Administrative Law

Sac/Delta Update: Key Milestones

- Early 2022: expected submittal of proposed voluntary agreement
- Winter – Summer 2022: development of Scientific Basis Report for any voluntary agreement, including public review and comment
- Fall 2022: Draft Staff Report public review and comment
- Winter 2023: Public workshop on Draft Staff Report
- Early Fall 2023: Response to comments and development of proposed final changes to the Bay-Delta Plan
- Late Fall 2023: Board consideration of adoption

Draft Biological Goals for Lower San Joaquin River Flow Objectives

On June 24, the State Water Resources Control Board (State Water Board), released a notice that it is seeking written public comments on revised draft initial biological goals[7] for fall-run Chinook salmon in the lower San Joaquin River and its three salmon-bearing tributaries, the Stanislaus, Tuolumne, and Merced Rivers (collectively "LSJR") developed pursuant to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan or Plan), as amended on December 12, 2018.

State Water Board staff also plan to hold a technical workshop to receive input and recommendations on possible revisions and improvements to the revised draft initial biological goals from members, or potential members, of the STM Working Group and the public. The remote workshop is scheduled to be held on July 18, from 1:00 to 5:00 pm.

Workshop Topics

The workshop is offered to seek recommendations and comments from members, or potential members, of the STM Working Group and public on revisions to the revised draft initial biological goals for the LSJR. Staff specifically request input on biological goals that will contribute to meeting the overall goals for salmon populations, including the salmon doubling objective, and

[7] https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/biological_goals/draft-biological-goals-06242022-hard-tracks.pdf

inform management of flow conditions to maintain viable native San Joaquin River fish populations migrating through the Delta for the following topics:

1. Definition – The Bay-Delta Plan requires biological goals to be specific, measurable, achievable, result-focused, and time-bound (SMART).
2. Achievability – Sources of additional evidence that inform whether the quantitative values, time-frame, and averaging periods of the revised draft initial biological goals are achievable.
3. Role – The Bay-Delta Plan states that the biological goals will be used to evaluate effectiveness of the program of implementation and inform adaptive methods, the San Joaquin Monitoring and Evaluation Program (not yet initiated), and future changes to the Bay-Delta Plan.
4. Abundance – The use of escapement as the metric for defining the abundance goal, identifying a specific numeric value for abundance and a time-frame for achieving the escapement value, and feasibility of the abundance goal.
5. Salmon Protection Objective – The role of biological goals with respect to the salmon protection objective and the relationship between the salmon protection objective1 and biological goals.
6. Hatchery Issues – The inclusion of adult hatchery fish as contributing to the abundance goal, feasibility of improving hatchery marking practices for fall-run Chinook salmon, and feasibility of and means for completing and implementing hatchery management plans for fall-run Chinook salmon in San Joaquin River tributary hatcheries.
7. Process – The process for adoption of revised draft initial biological goals and future review and updates to any adopted biological goals.

Written comments on the Revised Draft Initial Biological Goals report must be received by **noon on Monday, August 1, 2022.**

Voluntary Agreements

On March 29, 2022, members of the Newsom Administration joined federal and local water leaders in announcing the signing of a memorandum of understanding[8] that advances integrated efforts to improve ecosystem and fisheries health within the Sacramento-San Joaquin Bay-Delta. State and federal agencies also announced an agreement[9] specifically with the Sacramento River Settlement Contractors on an approach for 2022 water operations on the Sacramento River.

Both announcements represent a potential revival of progress toward what has been known as "Voluntary Agreements," an approach the Authority believes is superior to a regulatory approach to update the Bay-Delta Water Quality Control Plan.

[8] Available at https://resources.ca.gov/-/media/CNRA-Website/Files/NewsRoom/Voluntary-Agreement-Package-March-29-2022.pdf
[9] Available at https://calepa.ca.gov/2022/03/29/informational-statement-state-federal-agencies-and-sacramento-river-settlement-contractors-agree-on-approach-for-2022-water-operations-on-the-sacramento-river/

The broader MOU outlines terms for an eight-year program that would provide substantial new flows for the environment to help recover salmon and other native fish. The terms also support the creation of new and restored habitat for fish and wildlife, and provide significant funding for environmental improvements and water purchases, according to a joint news release from the California Natural Resources Agency and the California Environmental Protection Agency (CalEPA). Local water agency managers signing the MOU have committed to bringing the terms of the MOU to their boards of directors for their endorsement and to work to settle litigation over engaged species protections in the Delta.

On June 16, the SLDMWA, Friant Water Authority and Tehama Colusa Canal Authority signed onto the VA MOU.

Racial Equity Plan

In May, community partners and State Water Board management and staff came together for Visioning and Strategy retreats, as well as a series of Action Planning workshops. The draft Racial Equity Action Plan will set goals for the State Water Board to address racial inequities and identify metrics to measure progress.

The Water Board is inviting you to provide input on the Racial Equity Action Plan through a series of public engagement workshops across the state. During each session, Board staff will inform communities about the Water Boards' progress since the Racial Equity Resolution was adopted.

Here are the ways that you and your community can provide feedback:

Statewide Virtual Workshop (Notice)

- July 20, 2022. 5:30-7:30 PM. Zoom.

Regional In Person and Virtual Workshops

- Northern California (Redding, CA): July 21, 2022. 4 – 6:30 PM.
- Southern California (Mecca, CA): July 25, 2022. 4 – 6:30 PM.
- Central California (Visalia, CA): July 27, 2022. 4 – 6:30 PM.

To Register, and for agendas and background materials, click here.

Water Blueprint for the San Joaquin Valley Activity

Background

The Water Blueprint for the San Joaquin Valley (Blueprint) is a non-profit group of stakeholders, working to better understand our shared goals for water solutions that support environmental stewardship with the needs of communities and industries throughout the San Joaquin Valley.

Strategic Planning

The Blueprint's new board of 20 directors and other participants conducted extensive strategic planning, facilitated by Amy Wolfe. It produced a focused Mission and Vision statement as shown below, and crafted the Blueprint's strategic priorities for 2022-2025, deliverables, actions, and timelines. The priorities focus on the following: Advocacy, Groundwater Quality and Disadvantaged Communities, Land Use Changes & Environmental Planning, Outreach &

Communications, SGMA Implementation, Water Supply Goals, Governance, Operations & Finance.

The Blueprint Board has also identified quantifiable objectives, timelines for action and systems of accountability. The Large group met on June 22nd to review the 3-year plan and to collect input and support for the plan.

Mission Statement: *"Unifying the San Joaquin Valley's voice to advance an accessible, reliable solution for a balanced water future for all."*

Vision Statement: *"The Water Blueprint serves as the united voice to champion water resource policies and projects to maximize accessible, affordable, and reliable supplies for sustainable and productive farms and ranches, healthy communities, and thriving ecosystems in the San Joaquin Valley."*

Committees

The Board established the following official standing committees:

- Technical
- Executive/Budget/Personnel
- Advocacy
- Community/Outreach

Chairs and committee members are being nominated and filled in the next two months.

Advocacy

The Blueprint prepared and is transmitting a letter with a SJV funding flyer to highlight and identify needs for state elected and policy makers. It consists of:

- Interregional Water Planning: $10 million (fish friendly diversions pilot)
- Conveyance: $835 million
- Regional Resilience and Sustainability: $1.5 billion
- Multi-Benefit Land Repurposing: $1 billion

Drinking Water Feasibility

A draft drinking water feasibility study proposal has been prepared by Fresno State/California Water Institute covers 5 counties within the San Joaquin Valley to identify 20 spots that are technically and financially feasible for groundwater recharge that have multiple benefits and specifically DACs with no other options but groundwater. Fresno State, FWA, Self Help, Sustainable Conservation and Leadership Council have been working on this over the past year and are discussing funding opportunities with Senator Feinstein's office and DWR. Friant Contractors/managers are sharing projects they are pursuing and exploring the ability to identify tangible and/or direct benefits to drinking water supplies.

Authority staff is working to expand the scope of this potential study to include communities and projects adjacent to the San Luis and Delta-Mendota Canals.

San Joaquin Valley Water Collaborative Action Program (SJVW CAP)

The CAP plenary group continues to meet, most recently it received a presentation from PPIC related to water supplies and the delta. CAP produced a Phase I Framework with solution set elements that all 5 caucuses have yet to endorse. A small work group of the caucuses are meeting to draft a term sheet for agreement, sticking points remain around evaluating Delta water supplies and land fallowing.

By September 2022, the CAP intends to complete the following:

- An initial list of projects that are consistent with the CAP criteria that can improve water supplies. These projects will be supported by the CAP participants.
- Review and analysis of updated Delta study by the PPIC.
- Workplan for activities necessary to finish the 2023 comprehensive plan to reach sustainability by 2040.

By September 2023:

- The in-Valley and Delta opportunities assessments.
- Regional action plan for strategic land repurposing
- List of actions and projects that will achieve a water balance by 2040.

APPENDIX

San Luis & Delta-Mendota Water Authority

P.O. Box 2157
Los Banos, CA 93635
Phone: (209) 826-9696
Fax: (209) 826-9698

June 13, 2022

VIA EMAIL

Ms. Cynthia Meyer
Bureau of Reclamation
Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

Cynthia Meyer: cameyer@usbr.gov

Re: Knowledge Base Document Review: Long-Term Operation of the Central Valley Project and State Water Project

Dear Ms. Meyer:

The San Luis & Delta-Mendota Water Authority ("Water Authority") appreciates the opportunity to perform a supplementation review on the following Knowledge Base Documents associated with the 2021 Reinitiation of Consultation ("Consultation") on Long-Term Operation of the Central Valley Project ("CVP") and State Water Project ("SWP"):

1. Spring-run Juvenile Production Estimate- Spring-run Survival Knowledge Base Document, May 2022
2. Steelhead Juvenile Production Estimate-Steelhead Survival Knowledge Base Document, April 2022
3. Old and Middle River Reverse Flow Management – Smelt, Chinook Salmon, and Steelhead Migration and Survival Knowledge Base Document, May 2022
4. Central Valley Tributary Habitat Restoration Effects on Salmonid Growth and Survival Knowledge Based Paper, March 2022

The Water Authority is a public agency with its principal office located in Los Banos, California. It was formed in 1992 as a joint powers authority, and has twenty-seven member agencies. Twenty-five of the Water Authority's member agencies contract with the United States for the delivery of water from the federal CVP. Most of the Water Authority's member agencies depend upon the CVP as the principal source of water they provide to users within their service areas. That water supply serves approximately 1.2 million acres of agricultural lands within areas of San Joaquin, Stanislaus, Merced, Fresno, Kings, San Benito, and Santa Clara Counties, a portion of the water supply for nearly 2 million people, including in urban areas within Santa Clara County referred to as the "Silicon Valley," and millions of waterfowl that depend upon nearly 200,000 acres of

managed wetlands and other critical habitat within the largest contiguous wetland in the western United States. The operations of the CVP are therefore of vital interest and importance to the Water Authority, its member agencies, and the people, farms, businesses, communities, and wildlife refuges they serve.

During this review, the Water Authority looked for knowledge gaps and if found, literature and gray literature searches[1] were conducted. The papers and reports that add to the knowledge base are listed below, with the aim of ensuring that the best available science is incorporated into the 2021 Consultation.

1 SPRING-RUN JUVENILE PRODUCTION ESTIMATE – SPRING-RUN SURVIVAL

1.1 CLIMATE CHANGE

Thompson, L. C., Escobar, M. I., Mosser, C. M., Purkey, D. R., Yates, D., & Moyle, P. B. (2012). Water management adaptations to prevent loss of spring-run Chinook salmon in California under climate change. Journal of Water Resources Planning and Management, 138(5), 465-478.

Yates D, Galbraith H, Purkey D, Huber-Lee A, Sieber J, West J, Herrod-Julius S, and B. Joyce. 2008. B. Climate warming, water storage, and Chinook salmon in California's Sacramento Valley. Climatic Change. 91(3):335-50.

1.2 SALVAGE AND LOSS

One salvage query platform is SacPAS: https://www.cbr.washington.edu/sacramento/workgroups/.

Kimmerer (2008) discussed the loss of Chinook salmon juveniles. Wim Kimmerer's evaluation looked at all runs including Spring-run Chinook salmon.

1.3 JUVENILE PRODUCTION ESTIMATE

In the SRD, Reclamation makes the following statement: "In Spring 2022, DWR published the Incidental Take Permit Spring-Run Chinook Salmon Juvenile Production Estimate Science Plan (JPE Science Plan) which is a resource that outlines ongoing and future research and monitoring to support development of a SR JPE." However, Reclamation did not provide any citation for the JPE Science Plan call-out, here is the full citation:

DWR et al. 2020. INCIDENTAL TAKE PERMIT SPRING-RUN CHINOOK SALMON JUVENILE PRODUCTION ESTIMATE SCIENCE PLAN: 2020-2024. Department of Water Resources, Sacramento, CA. Accessed 5-26-2022 online at https://water.ca.gov/-

[1] Using AFS Gray Literature database located at https://graylitreports.fisheries.org/about

/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Files/ITP/ITP-Spring-run-Chinook-Salmon-JPE-Science-plan-final-approved_Final_PDF_04-05-22.pdf.

1.4 Spring-run Chinook Salmon Survival and Routing

Singer, G. P., Chapman, E. D., Ammann, A. J., Klimley, A. P., Rypel, A. L., & Fangue, N. A. (2020). Historic drought influences outmigration dynamics of juvenile fall and spring-run Chinook Salmon. Environmental Biology of Fishes, 103(5), 543-559.

Notch, J. J., McHuron, A. S., Michel, C. J., Cordoleani, F., Johnson, M., Henderson, M. J., & Ammann, A. J. (2020). Outmigration survival of wild Chinook salmon smolts through the Sacramento River during historic drought and high water conditions. Environmental Biology of Fishes, 103(5), 561-576.

Cordoleani, F., Notch, J., McHuron, A. S., Michel, C. J., & Ammann, A. J. (2019). Movement and survival rates of Butte Creek spring-run Chinook salmon smolts from the Sutter Bypass to the Golden Gate Bridge in 2015, 2016, and 2017.

Notch, J. (2017). Out-migration survival of wild Chinook Salmon (Oncorhynchus tshawytscha) smolts from Mill Creek through the Sacramento River during drought conditions. University of California, Santa Cruz. M. S. Thesis.

1.5 Butte Creek Studies

Mosser, C. M., Thompson, L. C., & Strange, J. S. (2013). Survival of captured and relocated adult spring-run Chinook salmon Oncorhynchus tshawytscha in a Sacramento River tributary after cessation of migration. Environmental Biology of Fishes, 96(2), 405-417.

1.6 Improvements to "Literature" Section

A problem with the Spring-Run Document was the listing of citations in the Literature Section that could not be obtained. This was not because the source material does not exist but because the full citation was not sufficient to allow an interested reader to find the document. This is one of the citations that were insufficient and need to be improved in the scoping and BA documents but there were others:

- [DWR] California Department of Water Resources. Data Management Strategy for the Spring Run Chinook salmon Juvenile Production Estimate. Draft report, 2022

1.7 Literature Cited

Salmonid Scoping Team. 2017. EFFECTS OF WATER PROJECT OPERATIONS ON JUVENILE SALMONID MIGRATION AND SURVIVAL IN THE SOUTH DELTA. Prepared for the Collaborative Adaptive Management Team. Accessed 5-21-2022 online at: https://www.fisheries.noaa.gov/resource/document/effects-water-project-operations-juvenile-salmonid-migration-and-survival-south.

Kimmerer, W. J. (2008). Losses of Sacramento River Chinook salmon and delta smelt to entrainment in water diversions in the Sacramento–San Joaquin Delta. San Francisco Estuary and Watershed Science, 6(2). Accessed 5-26-2022 online at https://escholarship.org/content/qt7v92h6fs/qt7v92h6fs.pdf.

Cavallo, B. et al. 2015. Predicting juvenile Chinook routing in riverine and tidal channels of a freshwater estuary. Environmental Biology of Fishes 98(6):1571-1582.

Cavallo, B., J. Merz, J. Setka. 2012. Effects of predator and flow manipulation on Chinook Salmon (Oncorhynchus tshawytscha) survival in an imperiled estuary. Environmental Biology of Fish. Published online April 2012. DOI 10.1007/s10641-012-9993-5.

J. Merz, M. Workman, D. Threloff, and B. Cavallo. 2013. Salmon life cycle considerations to guide stream management: examples from California's Central Valley. San Francisco Estuary and Watershed Science 11(2). Available at: http://www.escholarship.org/uc/item/30d7b0g7.

Cavallo, B., P. Gaskill, J. Melgo. 2012. Investigating the influence of tides, inflows, and exports on sub-daily flow in the Sacramento-San Joaquin Delta. Available at: http://www.fishsciences.net/reports/2013/Cavallo_et_al_Delta_Flow_Report.pdf.

Cavallo B., et al. 2016. Coleman National Fish Hatchery Adaptive Management Plan. United States Bureau of Reclamation. December 2016. Available at: https://www.usbr.gov/mp/battlecreek/docs/pd-cnfhamp.pdf.

Cavallo B., et al. 2014. Hatchery and Genetics Management Plan for Feather River Hatchery Spring-run Chinook Program. California Department of Water Resources. June, 2014.

Seesholtz, A., B. Cavallo, and others. 2003. Lower Feather River juvenile fish communities: distribution, emigration patterns, and association with environmental variables. American Fisheries Society Symposium 39:141-166.

Zeug, S.C. & B.J. Cavallo. 2014. Controls on the entrainment of juvenile Chinook Salmon (Oncorhynchus tshawytscha) into large water diversions and estimates of population-level loss. PLoS One 9(7):e101479. Doi:10.1371/journal.pone.0101479.

Zeug, S.C. & B.J. Cavallo. 2013. Influence of estuary conditions on the recovery rate of coded wire tagged Chinook Salmon (Oncorhynchus tshawytscha) in an ocean fishery. Ecology of Freshwater Fish 22:157-168.

Zeug, S.C., P.S. Bergman, B.J. Cavallo and K.S. Jones. 2012. Application of a life cycle simulation model to evaluate impacts of water management and conservation actions on an endangered population of Chinook Salmon. Environmental Modeling and Assessment 17:455-467.

Anderson, J.J. 2018. Using river temperature to optimize fish incubation metabolism and survival: a case for mechanistic models. bioRχiv preprint.

Beacham, T.D., Murray, C.B. 1990. Temperature, egg size, and development of embryos and alevins of five species of Pacific salmon: a comparative analysis. Transactions of the American Fisheries Society 119:927-945.

California Department of Fish and Wildlife (CDFW). 2016. Chinook Salmon Populations of the Upper Sacramento River Basin In 2015. RBFO Technical Report No. 03-2016.

California Department of Fish and Wildlife, Fisheries Branch. 2019. California Central Valley Chinook Population Database Report. 2019. GrandTab 2019.05.07.

Del Rio, A.M., B.E. Davis, N.A. Fangue and A.E. Todgham. 2019. Combined effects of warming and hypoxia on early life stage Chinook salmon physiology and development. Conservation Physiology. 7. 10.1093/conphys/coy078.

Dumas, J., Marty, S. 2006. A new method to evaluate egg-to-fry survival in salmonids, trials with Atlantic salmon. Journal of Fish Biology 68:284-304. oxygen regimes. Transactions of the American Fisheries Society 135:1462-1477.

Martin, B.T., Pike, A., John, S.N., Hamda, N., Roberts, J., Lindley, S. & Danner, E.M. 2017. Phenomenological vs. biophysical models of thermal stress in aquatic eggs. Ecology Letters 20:50-59.

Munoz, N. J., A.P. Farrell, J.W. Heath, and B.D. Neff. 2014. Adaptive potential of a Pacific salmon challenged by climate change. Nature Climate Change 5: 163-166.

Poletto, J.B., Cocherell, D.E., Baird, S.E., Nguyen, T.X., Cabera-Stagno, V., Farrell, A.P., Fangue, N.A. 2017. Unusual aerobic performance at high temperatures in juvenile Chinook salmon, Oncorhynchus tshawytscha. Conservation Physiology. https://doi.org/10.1093/conphys/cow067.

Roni, P., Johnson C., De Boer, T., Pess, G., Dittman, A., Sear D. 2015. Interannual variability in the effects of physical habitat and parentage on Chinook salmon egg-to-fry survival. Canadian Journal of Fisheries and Aquatic Sciences 73:1-13.

Rubin, J.F. 1995. Estimating the success of natural spawning salmonids in streams. Journal of Fish Biology 46:603-622.

Vogel, D. A., and K. R. Marine. 1991. Guide to upper Sacramento River Chinook Salmon life history. Prepared by CH2M Hill for the U.S. Bureau of Reclamation, Central Valley Project, Redding, California.

2 STEELHEAD JUVENILE PRODUCTION ESTIMATE – STEELHEAD SURVIVAL

2.1 GENERAL

A Table of Acronyms should be included. Additionally, all acronyms should be defined with the initial use. For example: OMR, on page 1, is not defined anywhere in the document.

2.2 CONCEPTUAL MODELS

2.2.1 Adult Models

Steelhead Knowledge Base Document, Pg. 1, Paragraph 2: "Conceptual models link conditions to stressors that impact sheltering, migration, and foraging of juvenile steelhead."

Conceptual models should also include adult navigation upstream. A good conceptual model of salmonid adult navigation in the Central Valley can be found in Williams 2010: Life Stage Transition 3 (Pg. 26)). This model may be relied upon because it provides all the influences on adults transitioning from the bays upstream to spawning areas and it considers these influences on each spawning run.

2.2.2 Habitat Models

The relationship between spawning habitat and flow was evaluated using two models (PHABSIM and River2D) by Gard (2009). Gard's work was useful because it provided a flow/spawning habitat curve for steelhead in the Sacramento River (see Gard's (2009) Figure 10).

2.3 SALVAGE

The SHD provides one salvage query platform, SacPAS. However, there are also useful tools for exploring salvage and exports at the CDFW site: https://apps.wildlife.ca.gov/Salvage/Project?type=Export. Furthermore, the CDFW site provides useful information through its salvage density site: https://apps.wildlife.ca.gov/Salvage/Project?type=Density.

2.4 ANADROMY AND RESIDENCY

Operations of the CVP and SWP (subsequently the projects) have changed the lotic environments used by *Oncorhynchus mykiss* (*O. mykiss*) to execute its life history, which has modified the relative risk to species with anadromous life history. Papers and reports that could be incorporated in this effort are:

- Kendall et al. 2015
- Courter, I. et al. 2009
- Abadia-Cardoso et al. 2019
- Brodsky et al. 2020

2.5 STEELHEAD SURVIVAL AND ROUTING

Buchanan, R. 2010-2016. Six-Year Acoustic Telemetry Study annual reports. All available here: https://www.usbr.gov/mp/bdo/six-year-acoustic-telemetry-steelhead-study.html

For example, the last survival results report in this series was:

- Buchanan. 2018. 2016 Six-year acoustic telemetry steelhead study: statistical methods and results. Prepared for US Bureau of Reclamation, Sacramento, CA.

See also:

- Brodsky et al. 2020
- Delaney et al. 2014

2.6 FEATHER RIVER STUDIES

Two studies have been conducted in the lower Feather River with steelhead. These reports focus on growth and on the fish community with features steelhead:

- SP-F10 Task 3A Final Report: Distribution and Habitat use of Juvenile Steelhead and Other Fishes of the Lower Feather River. April 2004. http://orovillerelicensing.water.ca.gov/wg-reports_envir.html .
- SP-F10 Task 3B: Growth Investigations of Wild and Hatchery Steelhead in the Lower Feather River. April 2004. http://orovillerelicensing.water.ca.gov/wgreports_envir.html .

A presentation that focused on steelhead in the Feather River was:

Seesholtz, A., B. Cavallo, and others. 2003. Lower Feather River juvenile fish communities: distribution, emigration patterns, and association with environmental variables. American Fisheries Society Symposium 39:141-166.

2.7 IMPROVEMENTS TO "LITERATURE" SECTION

A problem with the SHD was the listing of citations in the Literature Section that could not be obtained. This was not because the source material does not exist but because the full citation was not sufficient to allow an interested reader to find the document. These are two of the citations that were insufficient and need to be improved in the scoping and BA documents but there were many others:

Killam, D. 2019a. Clear Creek video weir data for steelhead passage timing. Pages 1 in S. L. Gallagher, editor.

Lee, D. P., and J. Chilton. 2007. Hatchery and Genetic Management Plan for Nimbus Fish Hatchery Winter-Run Steelhead Program. Pages 134 in U.S. Department of Fish and Game, editor.

This citation may be removed:

California Department of Water Resources. 2008. Quantification of Pre-Screen Loss of Juvenile Steelhead within Clifton Court Forebay. Pages 136 in Fishery Improvements Section, editor.

Because it is cited properly in another location as:

Clark, K.W., M.D. Bowen, R.B. Mayfield, K.P. Zehfuss, J.D. Taplin, and C.H. Hanson (2009). Quantification of pre-screen loss of juvenile steelhead in Clifton Court Forebay. California Department of Water Resources, Bay-Delta Office, Fishery Improvements Section, Sacramento, CA. March 2009.

2.8 LITERATURE CITED

Abadia-Cardoso, A. Brodsky, B. Cavallo and others. 2019. Anadromy redux? Genetic analysis to inform development of an indigenous American River steelhead broodstock. Journal of Fish and Wildlife Management 10(1):137–147; e1944-687X. https://doi.org/10.3996/072018-JFWM-063.

Brodsky, A., S.C. Zeug, J.Nelson, J. Hannon, P.J. Anders, B. Cavallo. 2020. Does broodstock source affect post-release survival of steelhead? Implications for replacing a non-native hatcherystock for recovery. Environmental Biology of Fishes 103: 437-453.

Buchanan, R. 2018. 2016 Six-year acoustic telemetry steelhead study: statistical methods and results. Prepared for US Bureau of Reclamation, Sacramento, CA. Accessed 5-25-2022 online at: http://www.cbr.washington.edu/sites/default/files/papers/UW%206yr%20steelhead%20report%202016%20FINAL.pdf.

Courter, I. and others. 2009. Flow and temperature effects on life history diversity of *Oncorhynchus mykiss* in the Yakima River basin. Cramer Fish Sciences, Gresham, OR. Accessed 5-21-22 online at https://www.researchgate.net/profile/Casey-Justice-2/publication/265148435_Flow_and_temperature_effects_on_life_history_diversity_of_Oncorhynchus_mykiss_in_the_Yakima_River_basin/links/586d463808aebf17d3a7231a/Flow-and-temperature-effects-on-life-history-diversity-of-Oncorhynchus-mykiss-in-the-Yakima-River-basin.pdf.

Delaney, D., P. Bergman, B. Cavallo and J. Melgo. 2014. Stipulation study: steelhead movement and survival in the South Delta with adaptive management of Old and Middle River flows. California Department of Water Resources Technical Report. Sacramento, CA.

Gard, M. 2009. Comparison of spawning habitat predictions of PHABSIM and River2D models. International Journal of River Basin Management, March, 2009. Accessed 5-21-2022 online at https://www.researchgate.net/publication/232897717. DOI: 10.1080/15715124.2009.9635370.

Kendall, Neala W., John R. McMillan, Matthew R. Sloat, Thomas W. Buehrens, Thomas P. Quinn, George R. Pess, Kirill V. Kuzishchin, Michelle M. McClure, and Richard W. Zabel. 2015. Anadromy and residency in steelhead and rainbow trout (Oncorhynchus mykiss): a review of the processes and patterns. Canadian Journal of Fisheries and Aquatic Sciences, Volume 72, Number 3. https://doi.org/10.1139/cjfas-2014-0192.

Salmonid Scoping Team. 2017. EFFECTS OF WATER PROJECT OPERATIONS ON JUVENILE SALMONID MIGRATION AND SURVIVAL IN THE SOUTH DELTA. Prepared for the Collaborative Adaptive Management Team. Accessed 5-21-2022 online at: https://www.fisheries.noaa.gov/resource/document/effects-water-project-operations-juvenile-salmonid-migration-and-survival-south.

Williams, J.G. 2010. Life History Conceptual Model for Chinook salmon and Steelhead. DRERIP Delta Conceptual Model. Sacramento (CA): Delta Regional Ecosystem Restoration Implementation Plan. Accessed 5-21-2022 online at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=28422.

3 Old and Middle River Reverse Flow Management – Smelt, Chinook Salmon, and Steelhead Migration and Survival

3.1 Predation Reduction at Salvage Facilities

At least two reports have shown that predation on target species (Chinook salmon and Delta Smelt to name two) is a substantial problem in the primary channel at the Tracy Fish Collection Facility (TFCF). Two reports show substantial improvements in salvage when predators are removed from the primary channel.

Bark et al. (2013) showed a statistically significant improvement in Whole Facility Efficiency for Chinook salmon and Delta Smelt after TFCF predator removals were completed. For example, Bark et al.'s (2013) Table 3 showed this clearly:

Table 3.—Pre- versus post-predator removal WFE for delta smelt and juvenile Chinook salmon

Test Fish	Whole Facility Efficiency				t-Test P-value
	Pre	SE	Post	SE	
Delta smelt	9.33	2.63	26.5	5.86	0.0159
Chinook salmon	7.83	0.05	32.67	0.03	0.0009

Bridges et al. (2019) found similar results to those reported in Bark et al. (2013).

3.2 SALVAGE FACILITIES FISH DATA

Reclamation (Date Not Provided) provided a summary of three years of salvage data. It provides the relative proportion of all species obtained in the salvage from 2000 through 2003.

Some information on larval fish was summarized in Hiebert et al. 1995. For example, the size of fish and the timing of Delta Smelt larval entrainment to the TFCF is itemized. Also, Hiebert et al. (1995) provides a look at the proportional composition of fish eggs and larvae at the TFCF in the early 1990s.

3.3 TEMPORARY BARRIER EFFECTS ON SURVIVAL OF SALMONIDS IN THE SOUTH DELTA

In CDWR (2018), routing in the south Delta is shown through acoustic telemetry data.

3.4 LOSS AT THE SALVAGE FACILITIES

Calculations of loss by Tillotson and Gueta are described in the Knowledge Paper. However, other methods have been worked out that are not "in development" as these methods seem to be. These are described in these two papers:

Zeug SC, Cavallo BJ. 2014. Controls on the entrainment of juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) into large water diversions and estimates of population-level loss. PLoS ONE [accessed 2020 Sep 09];9(7):e101479. https://doi.org/10.1371/journal.pone.0101479

Willis, J., M.D. Bowen, S. Zeug, B. Cavallo, and T. Keegan. 2014. Second opinion report on independent review panel recommendations regarding incidental take quantification at Delta water export facilities. Report 663R0101 to California Department of Water Resources (CDWR) by Turnpenny Horsfield Associates, Ashurst, UK.

3.5 BEHAVIORAL GUIDANCE STRUCTURES IN THE DELTA

Currently, NMFS has required the placement of a Bio-Acoustic Fish Fence (BAFF) in the Sacramento River at its divergence with Georgiana Slough. The BAFF is a non-physical barrier that must be installed and maintained each year by the DWR. The BAFF is intended to keep anadromous salmonid juveniles in the Sacramento River and not enter Georgiana Slough increasing survival by avoiding central Delta routes (Perry et al. 2010, Perry and Skalski 2009). There are two published reports evaluating the BAFF in the Sacramento River:

- California Department of Water Resources (CDWR). 2015a. 2012 Georgiana Slough non-physical barrier performance project report. Department of Water Resources Technical Report. Sacramento, CA. [See Literature Cited for online access information.].
- California Department of Water Resources (CDWR). 2012. 2011 Georgiana Slough non-physical barrier performance project report. Department of Water Resources Technical Report. Sacramento, CA. [See Literature Cited for online access information.].

CDWR (2015b) described the routing of steelhead and Fall Run Chinook Salmon (FRCS) into the Old River and the San Joaquin mainstem in a Wet year with no barrier (2011) and in other years

with rock barrier (2012) or non-physical fish barrier (BAFF) treatments (2009, 2010). CDWR (2015b) also estimated the proportion of salmonids lost due to predation. The authors also found there was significantly greater probability of predation with BAFF on or rock barrier than with BAFF off. Probability of predation was also positively related to small-fish density.

3.6 DATASETS

The Pacific States Marine Fisheries Commission maintains a database of all coded wire tagged releases. It can be found here: https://www.rmpc.org/.

3.7 CLIMATE CHANGE

Brown et al. (2016) showed how climate change models could be downscaled to evaluate effects on the ecosystem and in turn how that would affect an endangered fish: Delta Smelt.

3.8 MODELING DELTA SMELT MOVEMENT AND ENTRAINMENT

Gross et al. (2017) examined different Delta Smelt movement strategies. Gross et al. (2017) used a particle tracking model (PTM) and their results "suggest that somewhat realistic outcomes can be achieved by some form of selective tidal migration. It particularly shows support for tidal migration triggered by high salinity or perceived increases in salinity."

These manuscripts and reports also examined Delta Smelt. Together, they can be used to predict Delta Smelt movement and entrainment to the projects' facilities:

Korman, J, Gross, E, Smith, PE, Saenz, B, Grimaldo, LF (2018). Statistical evaluation of particle-tracking models predicting proportional entrainment loss for adult Delta smelt in the Sacramento-San Joaquin Delta. CSAMP/CAMT report.

Korman et al. 2021. Statistical Evaluation of Behavior and Population Dynamics Models Predicting Movement and Proportional Entrainment Loss of Adult Delta Smelt in the Sacramento–San Joaquin River Delta. San Francisco Estuary and Watershed Science, 19(1). https://doi.org/10.15447/sfews.2021v19iss1art1.

Gross, E.S. et al. 2021. Modeling Delta Smelt Distribution for Hypothesized Swimming Behaviors. San Francisco Estuary and Watershed Science, 19(1). https://doi.org/10.15447/sfews.2021v19iss1art3.

3.9 BIOLOGY OF INLAND FISHES OF CALIFORNIA

Moyle (2002) provides the most comprehensive coverage of biology of inland fishes. It is essential to understand the basics of distribution, life history, and many other attributes of fishes such as Chinook salmon, steelhead, Green Sturgeon, and Delta Smelt.

3.10 IMPROVEMENTS TO "LITERATURE" SECTION

A problem with the Old and Middle River Document was the listing of citations in the Literature Section that could not be obtained. This was not because the source material does not exist but because the full citation was not sufficient to allow an interested reader to find the document. These are two of the citations that were insufficient and need to be improved in the scoping and BA documents but there were many others:

Boles, G.L. 1988. Water Temperature Effects on Chinook Salmon with Emphasis on the Sacramento River: A Literature Review. Page 48 in California Department of Water Resources, editor.

Hughes, R.M., G.E. Davis, and C.E. Warren. 1978. Temperature requirements of salmonids in relation to their feeding, bioenergetics, growth, and behavior.

These citations were improved to include sufficient information for being able to obtain them:

Bowen, M.D., S. Hiebert, C. Hueth, and V. Maisonneuve. 2009. 2009 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA). US Bureau of Reclamation, Technical Services Center, Lakewood, CO. Accessed 5-24-22 online at https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/sjrf_spprtinfo/bowen_etal_2009.pdf.

Bowen, M.D. and R. Bark. 2012. 2010 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA). Technical Memorandum 86-68290-10-07. US Bureau of Reclamation, Technical Services Center, Lakewood, CO.

3.11 LITERATURE CITED

Bark, R.C., B. Bridges, and M.D. Bowen. 2013. Predator impacts on salvage rates of juvenile Chinook Salmon and Delta Smelt. Tracy Technical Bulletin 2013-1. Prepared for the US Bureau of Reclamation, Tracy Fish Collection Facility by the Fisheries and Wildlife Resources Group, Denver, CO. Accessed 5-25-2022 online at https://usbr.contentdm.oclc.org/digital/collection/p15911coll3/id/2669.

Bowen, M.D., S. Hiebert, C. Hueth, and V. Maisonneuve. 2009. 2009 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA). US Bureau of Reclamation, Technical Services Center, Lakewood, CO. Accessed 5-24-22 online at https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/sjrf_spprtinfo/bowen_etal_2009.pdf.

Bowen, M.D. and R. Bark. 2012. 2010 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA). Technical Memorandum 86-68290-10-07. US Bureau of Reclamation, Technical Services Center, Lakewood, CO.

Bridges, Brent B., Brandon J. Wu, Rene C. Reyes, Mark D. Bowen, and Raymond C. Bark. 2019. Effects of Striped Bass Predation on Salvage of Adult Delta Smelt and Juvenile Chinook Salmon at the Tracy Fish Collection Facility. Tracy Fish Collection Facility Studies, Tracy

Series Volume 45. Bureau of Reclamation, Mid-Pacific Region, 77 pp. Accessed 5-25-2022 online at https://www.usbr.gov/mp/TFFIP/docs/tracy-reports/tracyseriesvol45-bridgesetal-aug2019.pdf.

Brown, L. R., Komoroske, L. M., Wagner, R. W., Morgan-King, T., May, J. T., Connon, R. E., & Fangue, N. A. (2016). Coupled downscaled climate models and ecophysiological metrics forecast habitat compression for an endangered estuarine fish. PloS one, 11(1). Accessed 5-25-2022 online at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0146724.

California Department of Water Resources (CDWR). 2018. Effect of the South Delta Agricultural Barriers on Migrating Anadromous Juvenile Salmonids. Department of Water Resources Technical Report. Sacramento, CA. Accessed 5-23-2022 online at https://www.noaa.gov/sites/default/files/legacy/document/2020/Oct/07354626771.pdf.

California Department of Water Resources (CDWR). 2015a. 2012 Georgiana Slough non-physical barrier performance project report. Department of Water Resources Technical Report. Sacramento, CA. Accessed 5-24-2022 online at https://www.noaa.gov/sites/default/files/legacy/document/2020/Oct/07354626712.pdf.

California Department of Water Resources (CDWR). 2015b. An evaluation of juvenile salmonid routing and barrier effectiveness, predation, and predatory fishes at the Head of Old River, 2009–2012. Department of Water Resources Technical Report. Sacramento, CA. Accessed 5-23-2022 online at https://www.researchgate.net/publication/360797376_An_evaluation_of_juvenile_salmonid_routing_and_barrier_effectiveness_predation_and_predatory_fishes_at_the_Head_of_Old_River_2009-2012.

California Department of Water Resources (CDWR). 2012. 2011 Georgiana Slough non-physical barrier performance project report. Department of Water Resources Technical Report. Sacramento, CA. Accessed 5-24-2022 online at https://www.noaa.gov/sites/default/files/legacy/document/2020/Oct/07354626491.pdf.

Gross, E, Saenz, B, Rachiele, R, Grinbergs, S, Grimaldo, L, Korman, J, Smith, P, MacWilliams, M, Bever, A. (2017). Estimation of Adult Delta Smelt Distribution for Hypothesized Swimming Behaviors Using Hydrodynamic, Suspended Sediment and Particle- Tracking Models. Collaborative Adaptive Management Team Report. Accessed 5-25-2022 online at https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/part2_rebuttal/dwr_1249.pdfhttps://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/part2_rebuttal/dwr_1249.pdf.

Hiebert, S., C. Liston, P. Johnson, C. Karp, L. Hess, 1995. Continuous Monitoring of Fish Eggs and Larvae, 1991-1992. April 1995. Tracy Fish Collection Facility Studies, Volume 2, U.

S. Bureau of Reclamation, Mid-Pacific Region and Denver Technical Service Center. 55 pp. Accessed 5-23-2022 online at https://www.usbr.gov/mp/TFFIP/docs/tracy-reports/tracy-rpt-vol-2-continuous-monitoring-fish-eggs.pdf.

Moyle, P. B. (2002). Inland fishes of California: revised and expanded. University of California Press, Berkeley, CA.

Murphy DD, Hamilton SA (2013) Eastward Migration or Marsh-ward Dispersal: Exercising Survey Data to Elicit an Understanding of Seasonal Movement of Delta Smelt. San Francisco Estuary and Watershed Science 11(3).

Perry, R. W., P. L. Brandes, P. T. Sandstrom, A. Ammann, B. MacFarlane, A. P. Klimley and J. R. Skalski. 2010. Estimating survival and migration route probabilities of juvenile Chinook salmon in the Sacramento–San Joaquin River Delta. North American Journal of Fisheries Management. 30:142–156.

Perry, R. W. and J. R. Skalski. 2009. Migration and survival of juvenile Chinook salmon through the Sacramento–San Joaquin River Delta during the winter of 2007-2008. Technical Report to U.S. Fish and Wildlife Services, Stockton, California. Accessed 5-24-2022 online at https://nsgl.gso.uri.edu/casg/casgt09006.pdf.

Reclamation. U.S. Department of the Interior/Bureau of Reclamation. DNP (Date Not Provided). Three-Year Summary of Fish Salvaged at the TFCF. Tracy Field Office, Tracy, CA. Accessed 5-22-2022 online at https://www.usbr.gov/mp/TFFIP/docs/fish-salvaged-3-year-summary.pdf.

Puckett, K., C. Liston, C. Karp, and L. Hess. 1996. Preliminary Examination of Factors that Influence Fish Salvage Estimates at the Tracy Fish Collection Facility, California, 1993 and 1994. August 1996. Tracy Fish Collection Facility Studies, Volume 4, U. S. Bureau of Reclamation, Mid-Pacific Region and Denver Technical Services Center. 28 pp. Accessed 5-23-2022 online at https://www.usbr.gov/mp/TFFIP/docs/tracy-reports/tracy-rpt-vol-4-preliminary-exam-factors.pdf.

Willis, J., M.D. Bowen, S. Zeug, B. Cavallo, and T. Keegan. 2014. Second opinion report on independent review panel recommendations regarding incidental take quantification at Delta water export facilities. Report 663R0101 to California Department of Water Resources (CDWR) by Turnpenny Horsfield Associates, Ashurst, UK.

Zeug SC, Cavallo BJ. 2014. Controls on the entrainment of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) into large water diversions and estimates of population-level loss. PLoS ONE [accessed 2020 Sep 09];9(7):e101479. https://doi.org/10.1371/journal.pone.0101479.

4 CENTRAL VALLEY TRIBUTARY HABITAT RESTORATION EFFECTS ON SALMONID GROWTH AND SURVIVAL

The Habitat Restoration Document provides this dataset but this link does not work:

Final reports of information derived from Tributaries Monitoring Program on Battle Creek: Red Bluff FWO, Fish and Wildlife Service (doi.net)

4.1 CVPIA NEAR-TERM RESTORATION STRATEGY

The CVPIA Near-term Restoration Strategy (Reclamation and USFWS 2020) provided decision support modeling to prioritize restoration actions. The prioritization allowed optimization strategies and locations to be identified that were most likely, from among the options studied, to provide greater increases in listed fish species in the Central Valley.

4.2 RESTORATION EVALUATIONS

Chase et al. (2010) compared performance of two restoration sites to two mainstem Trinity River reference sites.

4.3 SALMONID POPULATION MONITORING

https://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/CDFWUpperSacRiverBasinSalmonidMonitoring.aspx

NOAA (2021) provided the juvenile production estimate for Winter-run Chinook Salmon for brood year 2020. This letter provided the estimated number of juvenile WRCS that would enter the Delta in Water Year (WY) 2021.

California Department of Fish and Wildlife (CDFW). 2021a. Final winter-run juvenile production estimate (JPE) for brood year 2020. January 15, 2021 letter from CDFW to NMFS.

California Department of Fish and Wildlife (CDFW). 2021b. Draft winter-run juvenile production estimate (JPE) for brood year 2021. December 31, 2021 letter from CDFW to NMFS.

Killam, D. S. (2006) Sacramento River winter-run Chinook salmon carcass survey summary report for years 1996-2006. SRSSAP Tech. Report No. 06-4, 2006.

O'Farrell, M, Hendrix, N., Mohr, M. 2016. An evaluation of preseason abundance forecasts for Sacramento River winter Chinook salmon. National Marine Fisheries Service, Santa Cruz, CA, October 3, 2016.

Poytress, W.R., Gruber, J.J., Carrillo, F.D., Voss, S.D. 2014. Compendium report of Red Bluff Diversion Dam rotary trap juvenile anadromous fish production indices for years 2000-2012. Report of U.S. Fish and Wildlife Service to California Department of Fish and Wildlife and U.S. Bureau of Reclamation.

4.4 Spring-run Chinook Salmon

Cordoleani, Flora, Jeremy Notch, Alex S. McHuron, Cyril J. Michel, and Arnold J. Ammann. 2019. Movement and survival rates of Butte Creek spring-run Chinook salmon smolts from the Sutter Bypass to the Golden Gate Bridge in 2015, 2016, and 2017. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-618. 47 p. https://doi.org/10.25923/cwry-bx03.

Cordoleani, F, Phillis, C.C., Sturrock, A.M., FitzGerald, A.M., Malkassian, A., Whitman, G.E., Weber, P.K., Johnson, R.C. 2021. Threatened salmon rely on a rare life history strategy in a warming landscape. Nature Climate Change https://doi.org/10.1038/s41558-021-01186-4.

4.5 Fall-run Chinook Salmon

Lindley, S.T., Grimes, C.B., Mohr, M.S., Peterson, W., Stein, J., Anderson, J.T., Botsford, L.W., Bottom, D.L., Busack, C.A., Collier, T.K., Ferguson, J., Garza, J.C., Grover, A.M., Hankin, D.G., Kope, R.G., Lawson, P.W., Low, A., MacFarlane, R.B., Moore, K., Palmer-Zwahlen, M., Schwing, F.B. , Smith, J., Tracy, C., Webb, R., Wells, B.K., Williams, T.H. 2009. What caused the Sacramento River fall Chinook stock collapse? Report to the Pacific Fishery Management Council.

4.6 Hyporheic Influences on Spawning Success

Geist, D.R. 2000. Hyporheic discharge of river water into fall Chinook salmon (Oncorhynchus tshawytscha) spawning areas in the Hanford Reach, Columbia River. Canadian Journal of Fisheries and Aquatic Sciences 57:1647-1656.

Barnard, K and S McBain. 1994. Standpipe to determine permeability, dissolved oxygen, and vertical particle size distribution in salmonid spawning gravels. Fish Habitat Relationships Technical Bulletin 15.

4.7 Independent Review Panel (IRP) Report

Gore, J., Kennedy, B., et al. (2018) Independent Review Panel (IRP) Report for the 2017 Long-term Operations Biological Opinions (LOBO) Biennial Science Review: Report to the Delta Science Program. Delta Stewardship Council and Delta Independent Science Program.

4.8 Spawning Gravel

Kondolf, G.M., M.J. Sale, and M.G. Wolman. 1993. Modification of fluvial gravel size by spawning salmonids. Water Resources Research. 29(7): 2265-2274.

Stillwater Sciences. 2007. Sacramento River Ecological Flows Study: Gravel study final report. December 21 2007.

Terhune, LDB. 1958. The Mark IV groundwater standpipe for measuring seepage through salmon spawning gravel. J Fish. Res. Bd. Canada, 15(5): 1027-1063.

Tonina, D and JM Buffington. 2009. A three-dimensional model for analyzing the effects of salmon redds on hyporheic exchange and egg pocket habitat. Canadian Journal of Fisheries and Aquatic Sciences 66:2157-2173.

Zimmermann AE, Lapointe M. 2005 Intergranular low velocity through salmonid redds: sensitivity to fines infiltration from low intensity sediment transport events. River Res. appl. 21, 865–881.

4.9 Recovery Plans

National Marine Fisheries Service. 2014. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. California Central Valley Area Office. July 2014.

4.10 Fecundity and Spawning Success Research

Quinn, T.P., Bloomberg, S. 1992. Fecundity of Chinook salmon (Oncorhynchus tshawytscha) from the Waitaki and Rakaia rivers, New Zealand. New Zealand Journal of Marine and Freshwater Research 1992:429-434.

Rubin, J.F. 1995. Estimating the success of natural spawning salmonids in streams. Journal of Fish Biology 46:603-622.

4.11 Off-channel Chinook Salmon Habitat

Bellido-Leiva, F.J.; Lusardi, R.A.; Lund, J.R. Quantification of Off-Channel Inundated Habitat for Pacific Chinook Salmon (Oncorhynchus tshawytscha) along the Sacramento River, California, Using Remote Sensing Imagery. Remote Sens. 2022, 14, 1443. https://doi.org/10.3390/rs14061443.

4.12 Restoration Potential

Phillis, C. C., Sturrock, A. M., Johnson, R. C., & Weber, P. K. (2018). Endangered winter-run Chinook salmon rely on diverse rearing habitats in a highly altered landscape. Biological Conservation, 217, 358-362.

4.13 Thiamine Monitoring

Monitoring Thiamine Deficiency in California Salmon – NOAA Program for determining the cause of thiamine deficiency in Chinook Salmon: https://www.fisheries.noaa.gov/west-coast/science-data/monitoring-thiamine-deficiency-california-salmon.

4.14 Biology of Inland Fishes of California

Moyle (2002) provides the most comprehensive coverage of biology of inland fishes. It is essential to understand the basics of distribution, life history, and many other attributes of fishes such as Chinook Salmon, steelhead, Green Sturgeon, and Delta Smelt.

4.15 Improvements to "Literature" Section

A problem with the Habitat Restoration was the listing of citations in the Literature Section that could not be obtained. This was not because the source material does not exist but because the full citation was not sufficient to allow an interested reader to find the document. This is a citation that was insufficient and should be improved in the scoping and BA documents but there were others:

Duffy, W.G. 2005. Protocols for monitoring the response of anadromous salmon and steelhead to watershed restoration in California. Report to CDFW. 84 p

4.16 Literature Cited: Full Citations for Call-Outs

Bellido-Leiva, F.J.; Lusardi, R.A.; Lund, J.R. Quantification of Off-Channel Inundated Habitat for Pacific Chinook Salmon (*Oncorhynchus tshawytscha*) along the Sacramento River, California, Using Remote Sensing Imagery. Remote Sens. 2022, 14, 1443. https://doi.org/10.3390/rs14061443.

Chase, R. et al. 2013. Assessment of juvenile coho salmon movement and behavior in relation to rehabilitation efforts in the Trinity River, California, using PIT tags and radiotelemetry. Environmental Biology of Fishes 96: 303-314.

National Oceanic and Atmospheric Administration. 2021. Juvenile Production Estimate (JPE) for Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) from brood year (BY) 2020 expected to enter the Sacramento-San Joaquin Delta (Delta) during water year (WY) 2021. Central California Valley Office, Sacramento, CA. Accessed 5-25-2022 online at https://media.fisheries.noaa.gov/2021-02/nmfs-by-2020-jpe-letter.pdf.

Reclamation and USFWS. U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. 2020. Near-term Restoration Strategy for the Central Valley Project Improvement Act Fish Resource Area FY2021–FY2025. Prepared for the Bureau of Reclamation and U.S. Fish and Wildlife Service. Sacramento, California. 100 pages. Accessed 5-26-2022 online at https://www.usbr.gov/mp/cvpia/3406b1/docs/cvpia-near-term-restoration-strategy-fy21-fy25.pdf.

5 CONCLUSION

The Water Authority appreciates this opportunity to submit these comments and looks forward to working with Reclamation and others in this process.

Sincerely,

J. Scott Petersen, P.E.
Director of Water Policy
San Luis & Delta-Mendota Water Authority

San Luis & Delta-Mendota Water Authority

P.O. Box 2157
Los Banos, CA 93635
Phone: (209) 826-9696
Fax: (209) 826-9698

June 20, 2022

VIA EMAIL

Ms. Cynthia Meyer
Bureau of Reclamation
Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

Cynthia Meyer: cameyer@usbr.gov

Re: Knowledge Base Document Review: Long-Term Operation of the Central Valley Project and State Water Project

Dear Ms. Meyer:

The San Luis & Delta-Mendota Water Authority ("Water Authority") appreciates the opportunity to perform a supplementation review on the following Knowledge Base Documents associated with the 2021 Reinitiation of Consultation ("Consultation") on Long-Term Operation of the Central Valley Project ("CVP") and State Water Project ("SWP"):

1. Delta Spring Outflow Management Smelt Growth and Survival Knowledge Base Document, May 2022
2. Pulse Flow Effects on Salmonid Survival Knowledge Base Document, May 2022
3. Summer and Fall Habitat Management Actions – Smelt Growth and Survival Knowledge Base Document, May 2022
4. Shasta Cold Water Pool Management – End of September Storage Knowledge Base Document, May 2022

The Water Authority is a public agency with its principal office located in Los Banos, California. It was formed in 1992 as a joint powers authority, and has twenty-seven member agencies. Twenty-five of the Water Authority's member agencies contract with the United States for the delivery of water from the federal CVP. Most of the Water Authority's member agencies depend upon the CVP as the principal source of water they provide to users within their service areas. That water supply serves approximately 1.2 million acres of agricultural lands within areas of San Joaquin, Stanislaus, Merced, Fresno, Kings, San Benito, and Santa Clara Counties, a portion of the water supply for nearly 2 million people, including in urban areas within Santa Clara County referred to as the "Silicon Valley," and millions of waterfowl that depend upon nearly 200,000 acres of managed wetlands and other critical habitat within the largest contiguous wetland in the western

United States. The operations of the CVP are therefore of vital interest and importance to the Water Authority, its member agencies, and the people, farms, businesses, communities, and wildlife refuges they serve.

During this review, the Water Authority looked for knowledge gaps and if found, literature and gray literature searches[1] were conducted. The papers and reports that add to the knowledge base are listed below, with the aim of ensuring that the best available science is incorporated into the 2021 Consultation.

1 DELTA SPRING OUTFLOW MANAGEMENT: SMELT GROWTH AND SURVIVAL

1.1 RESULTS

1.1.1 References for Outflows and Smelt Movement and Entrainment

Anchor QEA, 2017. Collaborative Adaptive Management Team Investigations on Understanding Factors that Affect Entrainment of Delta Smelt, Hydrodynamic and Sediment Transport Modeling Study, December 2017.

A review of the effects of Delta outflow and inflow on multiple species including Delta Smelt and Longfin Smelt is:

CDFG. 2010. Effects of Delta Inflow and Outflow on Several Native, Recreational, and Commercial Species. Bay-Delta Region, Stockton, CA. Accessed 5-27-2022 online at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/PCFFA&IGFR/part2/pcffa_146.pdf.

1.2 MODELS

1.2.1 FISH-PTM

FISH-PTM allows for the prediction of Delta Smelt distribution. References:

Gross et al. (2018) used multiple approaches to modeling Delta Smelt swimming behavior and conducted the first application of FISH-PTM for Delta Smelt. Gross et al. (2021) refined the model of Delta Smelt swimming behavior.

Specification of FISH-PTM was first done by Ketefian et al. (2016).

Resource Management Associates. 2017. Calibration of the Hydrodynamic, Salinity and Turbidity Models for the Adult Delta Smelt Behavior Study. Report for the Collaborative Adaptive Management Team.

[1] Using AFS Gray Literature database located at https://graylitreports.fisheries.org/about

1.2.2 IBM of Delta Smelt Population Dynamics

Rose KA, Kimmerer WJ, Edwards KP, Bennett WA. 2013. Individual-based modeling of delta smelt population dynamics in the upper San Francisco Estuary: I. Model description and baseline results. Transactions of the American Fisheries Society 142: 1238–1259.

1.3 Longfin Smelt References

Lewis, L. S., M. Willmes, A. Barros, P. K. Crain, and J. A. Hobbs. 2020. Newly discovered spawning and recruitment of threatened Longfin Smelt in restored and underexplored tidal wetlands. Ecology 101(1):e02868. 10.1002/ecy.2868.

Tobias, V., & Baxter, R. (2021). Fewer and farther between: changes in the timing of Longfin Smelt (Spirinchus thaleichthys) movements in the San Francisco Estuary. Accessed 5-27-2022 online at: https://www.preprints.org/manuscript/202101.0512/download/final_file.

1.4 Literature Cited: Full Citations for Call-Outs

Gross, ES, Saenz, B, Rachiele, R, Grinbergs, S, Grimaldo, LF, Korman, J, Smith, PE, MacWilliams M, Bever A. 2018. Estimation of adult Delta Smelt distribution for hypothesized swimming behaviors using hydrodynamic, suspended sediment and particle-tracking models. Walnut Creek (CA): Resource Management Associates. Technical Report DWR-1249. 58 p. Accessed 5-27-22 online at https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/part2_rebuttal/dwr_1249.pdf.

Gross, E., et al. 2021. Modeling Delta Smelt Distribution for Hypothesized Swimming Behaviors. San Francisco Estuary and Watershed Science, 19(1). https://doi.org/10.15447/sfews.2021v19iss1art3.

Hamilton Scott A, Murphy Dennis D. 2022. Identifying Environmental Factors Limiting Recovery of an Imperiled Estuarine Fish. Frontiers in Ecology and Evolution, 10(22). https://www.frontiersin.org/articles/10.3389/fevo.2022.826025/full

Ketefian GS, Gross ES, Stelling GS. 2016. Accurate and consistent particle tracking on unstructured grids, International Journal for Numerical Methods in Fluids, 80(11): 648–665, doi:10.1002/fld.4168.

2 Pulse Flow Effects on Salmonid Survival

2.1 Results

2.1.1 Datasets

The Pulse Flow Effects on Salmonid Survival Knowledge Base Document ("PFD") provides many useful datasets.

There are some datasets not listed in the PFD that could improve the understanding of pulse flows and their effects. Here is an example from the Stanislaus:

In the spring, juvenile salmonids in the San Joaquin River tributaries tend to emigrate from their natal streams when the hydrograph shows a steep ascending or descending limb. The existence of this relationship was supported by Chinook salmon fry releases in the Stanislaus River in 2003, experimental pulse flows, rotary screw trap (RST) Chinook salmon fry-catch rates, and subsequent observations of Chinook salmon fry at the salvage facilities (SJRGA 2004).

There are substantial datasets available for the Tuolumne River where a reader may compare RST catch rate to flow (cfs). Full citations for all 14 of these reports may be found in the Literature Cited section of this review: Turlock and Modesto Irrigation Districts. 2006 - 2019.

Here is an example of the pulse flow and RST data available for the Tuolumne River:

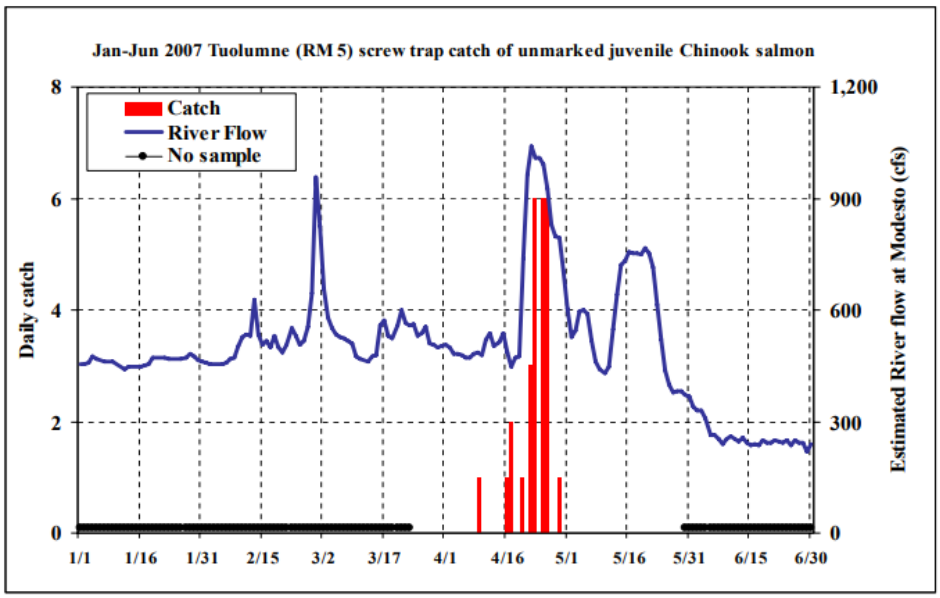

Figure 1. Source: Turlock and Modesto Irrigation Districts (2008)

There are a few datasets available for the Merced River where a reader may compare flow (cfs) at Cressey to the RST catch at River Mile 2 of the Merced River. See this figure:

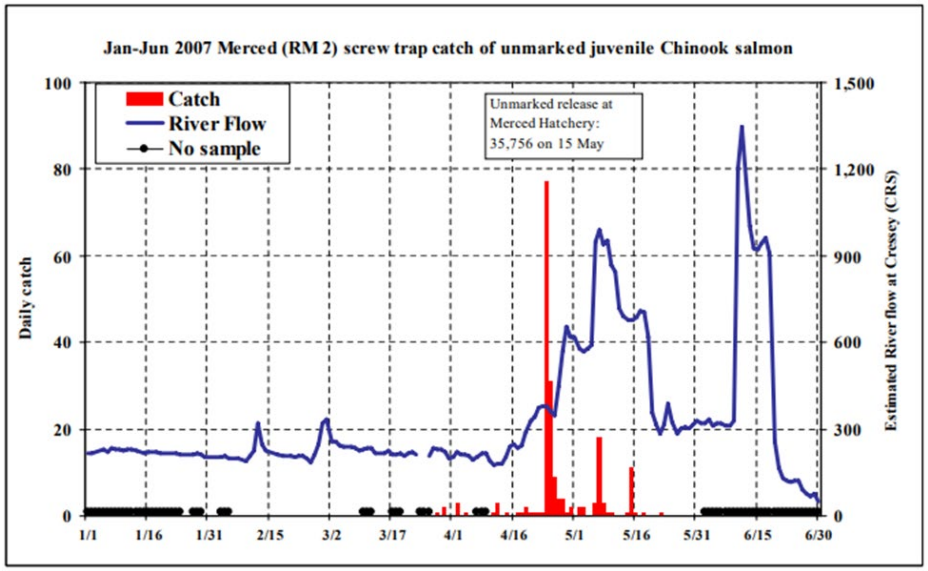

Figure 2. Source: Turlock and Modesto Irrigation Districts (2008)

These data sets show there is regularly a pulse in outmigration with a pulse flow. However, this is not always the case and so these datasets should be viewed in their entirety. The Merced River datasets are in this same dataset that was provided above: Turlock and Modesto Irrigation Districts. 2006 - 2019.

2.2 Literature Cited: Full Citations for Call-Outs

SJRGA (San Joaquin River Group Authority). 2004. Complimentary Studies Related to the VAMP. Chapter 6 in 2003 Annual Technical Report on Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. Prepared for the California Water Resources Control Board in compliance with D-1641. Accessed 5-27-2002 at https://calisphere.org/item/ark:/86086/n2sx6c5g/.

Turlock and Modesto Irrigation Districts. 2006. FERC Project No. 2299: 2005 Lower Tuolumne River Annual Report. Accessed 5-27-2002 online at: http://tuolumnerivertac.com/Documents/20060330-5125(14999182).pdf.

Turlock and Modesto Irrigation Districts. 2007. FERC Project No. 2299: 2006 Lower Tuolumne River Annual Report. Accessed 5-27-2002 online at: http://tuolumnerivertac.com/Documents/P-2299_Report_1-of-7.pdf and http://tuolumnerivertac.com/Documents/Tuolumne%20River%20Data%20Report%20-%202006.pdf.

Turlock and Modesto Irrigation Districts. 2008. FERC Project No. 2299: 2007 Lower Tuolumne River Annual Report. Accessed 5-27-2002 online at:

http://tuolumnerivertac.com/Documents/P-2299_2007_Summary_Rpt_Part.pdf and http://tuolumnerivertac.com/Documents/2007-4%20RST.pdf.

Turlock and Modesto Irrigation Districts. 2009. FERC Project No. 2299: 2008 Lower Tuolumne River Annual Report. Available: http://tuolumnerivertac.com/Documents/2008_Annual_Report_Part_1.pdf and http://tuolumnerivertac.com/Documents/2008%20Tuolumne%20Annual%20RST%20Report_FINAL.pdf. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2010. FERC Project No. 2299: 2009 Lower Tuolumne River Annual Report. Available: http://tuolumnerivertac.com/Documents/2009_FERC_Report_wo_technical_reports.pdf and http://tuolumnerivertac.com/Documents/Tuolumne%20RST%20Annual%20Report%202009_final.pdf. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2011. FERC Project No. 2299: 2010 Lower Tuolumne River Annual Report. Available: http://tuolumnerivertac.com/Documents/P-2299_2010_Summary_Report.pdf. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2012. FERC Project No. 2299: 2011 Lower Tuolumne River Annual Report. Available: http://tuolumnerivertac.com/Documents/2012_FERC_Report.pdf. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2013. FERC Project No. 2299: 2012 Lower Tuolumne River Annual Report. Available: http://elibrary.ferc.gov/IDMWS/common/OpenNat.asp?fileID=13216498. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2014. FERC Project No. 2299: 2013 Lower Tuolumne River Annual Report. Available: http://tuolumnerivertac.com/Documents/20140331-5180(29239341)(1).pdf. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2015. FERC Project No. 2299: 2014 Lower Tuolumne River Annual Report. Available: http://tuolumnerivertac.com/Documents/2014%20Annual%20Report%20to%20FERC.pdf. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2016. FERC Project No. 2299: 2015 Lower Tuolumne River Annual Report. Available: http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14444089. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2017. FERC Project No. 2299: 2016 Lower Tuolumne River Annual Report. Available:

https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14543006. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2018. FERC Project No. 2299: 2017 Lower Tuolumne River Annual Report. Available: https://elibrary.ferc.gov/IDMWS/common/OpenNat.asp?fileID=14857850. Accessed May 14, 2020.

Turlock and Modesto Irrigation Districts. 2019. FERC Project No. 2299: 2018 Lower Tuolumne River Annual Report. Available: https://elibrary.ferc.gov/idmws/file_list.asp?document_id=14756651. Accessed May 14, 2020.

3 SUMMER AND FALL HABITAT MANAGEMENT ACTIONS – SMELT GROWTH AND SURVIVAL

3.1 STOCK-RECRUITMENT AND SMALL SPAWNING STOCK

Beverton, R. J., and S. J. Holt. 1957. "On the Dynamics of Exploited Fish Populations." United Kingdom Ministry of Agriculture and Fisheries, Fishery Investigations, Series II, 19.

Hutchings Jeffrey A. 2015. Thresholds for impaired species recovery. Proc. R. Soc. B. 2822015065420150654. http://doi.org/10.1098/rspb.2015.0654. Accessed 5-28-2022 online at: https://royalsocietypublishing.org/doi/10.1098/rspb.2015.0654.

3.2 EXTINCTION RISK ANALYSIS AND POPULATION VIABILITY ANALYSIS EXAMPLES

NOAA. 2021. Guidance on Responding to Petitions and Conducting Status Reviews under the Endangered Species Act. Accessed 5-28-2022 online at: https://media.fisheries.noaa.gov/2021-02/Final%20Listing%20Guidance_%202017%20ver_revisions_02012021_external.pdf?null.

Pine, W. et al. 2013. An individual-based model for population viability analysis of humpback chub in Grand Canyon. North American Journal of Fisheries Management. https://doi.org/10.1080/02755947.2013.788587.

3.3 IMPROVEMENTS TO "LITERATURE" SECTION

A minor problem with the Habitat Management Document was the listing of citations in the Literature Section that could not be obtained. This was not because the source material does not exist but because the full citation was not sufficient to allow an interested reader to find the document. This is one of the citations that were insufficient and need to be improved in the scoping and BA documents but there were others:

CDWR 2022. Delta Smelt Summer-Fall Habitat Action 2022 Action Plan. Division of Integrated Science and Engineering, Sacramento CA. 32 pp + appendices.

4 SHASTA COLD WATER POOL AND STORAGE MANAGEMENT – CHINOOK SALMON AND STEELHEAD GROWTH AND SURVIVAL

4.1 RESULTS

4.1.1 Datasets

The Coldwater Pool Document (CDP) provides many useful datasets. The Trinity River Division is not discussed in the CPD. However, temperature concerns on the Trinity River and the Sacramento River are related. One excellent source for information on the Trinity River basin temperature issues is the Trinity River Restoration Program document storage site: https://www.trrp.net/library/. References from that library could inform the ESA Consultation regarding water temperatures in Lewiston Reservoir for water that would enter the Clear Creek Tunnel and arrive in Whiskeytown Reservoir:

Magneson, M. 2013. The Influence of Lewiston Dam Releases on Water Temperatures of the Trinity River and Lower Klamath River, CA. April to October, 2012. Report to the Trinity River Restoration Program, Arcata Fisheries Data Series Report Number DS 2013-30. U. S. Fish and Wildlife Service, Arcata, California. Available: https://www.trrp.net/library/document?id=2244.

Magneson, M. 2014. The Influence of Lewiston Dam Releases on Water Temperatures of the Trinity River and Lower Klamath River, CA. April to October, 2013. Arcata Fisheries Data Series Report Number DS 2014-36. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, CA. Available: https://www.trrp.net/library/document?id=2178.

Magneson, M. D. and C. D. Chamberlain. 2015. The influence of Lewiston dam releases on water temperatures of the Trinity River and lower Klamath River, CA, April to October 2014. U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2015-41, Arcata, California. Available: https://www.trrp.net/library/document?id=2211.

4.2 LITERATURE

Anderson, J.J. 2018. Using river temperature to optimize fish incubation metabolism and survival: a case for mechanistic models. Abstract only accessed 5-28-2022 online at: https://www.biorxiv.org/content/10.1101/257154.abstract.

Barnard, K and S McBain. 1994. Standpipe to determine permeability, dissolved oxygen, and vertical particle size distribution in salmonid spawning gravels. Fish Habitat Relationships Technical Bulletin 15.

Beacham, T.D., Murray, C.B. 1990. Temperature, egg size, and development of embryos and alevins of five species of Pacific salmon: a comparative analysis. Transactions of the American Fisheries Society 119:927-945.

Bellgraph, B.J., McMichael, G.A., Mueller, R.P. and Monroe, J.L., 2010. Behavioural response of juvenile Chinook salmon *Oncorhynchus tshawytscha* during a sudden temperature increase and implications for survival. Journal of Thermal Biology, 35(1), pp.6-10.

Bjorn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. In: "Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats", Meehan W.R. (ed.). American Fisheries Society, Special Publication Number 19. American Fisheries Society: Bethesda, MD: 83-138.

Boughton, D.A., Gibson, M., Yedor, R. and Kelley, E., 2007. Stream temperature and the potential growth and survival of juvenile Oncorhynchus mykiss in a southern California creek. Freshwater Biology, 52(7), pp.1353-1364.

Brewitt, K.S. and Danner, E.M., 2014. Spatio-temporal temperature variation influences juvenile steelhead (Oncorhynchus mykiss) use of thermal refuges. Ecosphere, 5(7), pp.1-26.

California Department of Fish and Wildlife. Killam, D., et al. (2016). Chinook Salmon Populations of the Upper Sacramento River Basin In 2015. RBFO Technical Report No. 03-2016.

California Department of Fish and Wildlife (CDFW). 2019. Salmonid Populations of the Upper Sacramento Basin in 2019. Including Excel tables to supplement report by the same title. Available: https://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/CDFWUpperSacRiverBasinSalmonidMonitoring.aspx

California Department of Fish and Wildlife (CDFW). 2021a. Final winter-run juvenile production estimate (JPE) for brood year 2020. January 15, 2021 letter from CDFW to NMFS.

California Department of Fish and Wildlife (CDFW). 2021b. Draft winter-run juvenile production estimate (JPE) for brood year 2021. December 31, 2021 letter from CDFW to NMFS.

California Department of Fish and Wildlife (CDFW). 2021c. California Central Valley Chinook Population Database Report. GrandTab.2021.06.30.

California Hatchery Scientific Review Group (CA HSRG). 2012. California Hatchery Review Project, Appendix VIII. Livingston Stone National Fish Hatchery, Winter Chinook Program Report. June 2012.

Carter, K., 2005. The effects of temperature on steelhead trout, coho salmon, and Chinook salmon biology and function by life stage. North Coast Region: California Regional Water Quality Control Board, pp.1-26.

Dumas, J., Marty, S. 2006. A new method to evaluate egg-to-fry survival in salmonids, trials with Atlantic salmon. Journal of Fish Biology 68:284-304.

Geist, D.R. 2000. Hyporheic discharge of river water into fall Chinook salmon (Oncorhynchus tshawytscha) spawning areas in the Hanford Reach, Columbia River. Canadian Journal of Fisheries and Aquatic Sciences 57:1647-1656.

Geist, D.R., Abernethy, C.S., Hand, K.D., Cullinan, V.I., Chandler, J.A. and Groves, P.A., 2006. Survival, development, and growth of fall Chinook salmon embryos, alevins, and fry exposed to variable thermal and dissolved oxygen regimes. Transactions of the American Fisheries Society, 135(6), pp.1462-1477.

Gore, J., Kennedy, B., et al. (2018) Independent Review Panel (IRP) Report for the 2017 Long-term Operations Biological Opinions (LOBO) Biennial Science Review: Report to the Delta Science Program. Delta Stewardship Council and Delta Independent Science Program.

Greig, S.M., Sear, D.A., Carling, P.A. 2005. The impact of fine sediment accumulation on the survival of incubating salmon progeny: implications for sediment management. Science of the Total Environment 344:241-258.

Hallnan, R.M. 2017. Modeling water temperature dynamics at Shasta Lake, California under the drought conditions of 2015. University of Nevada, Reno. M.S. Thesis.

Jager, H.I., 2011. Quantifying temperature effects on fall Chinook salmon. Oak Ridge, TN: US Department of Energy, Oak Ridge National Laboratory, 10, p.1047614. Accessed 5-28-2022 online at: https://d1wqtxts1xzle7.cloudfront.net/66371004/a51102496affa74bb30d69015cf1906a6740-with-cover-page-v2.pdf?Expires=1653760437&Signature=b1ZFS~Nk3~Zgu3-gBStgGn8VEK7VFWa2KNpC0gNVmeNJScPQocEJoAJOnogClUoXPV7MtAvhRVGGjg9SJo8lOy7lAGYloZcxLwdo3jTaRphsnaO9AF8~f~EmKXYtrgQLAkHPTe5E74YkziXqEKAY3G9qhMfjpo0KdNTuiT~Hc36FowX6z5euf0ZaztQoukoHD8T3cNzrKLH7aI-6cI7v~fHDgd1fNdSPwxXHcB5qR49cFdutN4lxqaN~NRdBocsWfv7ruGddIiiul3NTLG84baEoLw~za-acz8Nmd1btHetwnX0H68OYCBqJ-5BjBWMP-~XsxrftGWZ1Uuy~FbrGQw__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA.

Killam, D. S. (2006) Sacramento River winter-run Chinook salmon carcass survey summary report for years 1996-2006. SRSSAP Tech. Report No. 06-4, 2006.

Kondolf, G.M., M.J. Sale, and M.G. Wolman. 1993. Modification of fluvial gravel size by spawning salmonids. Water Resources Research. 29(7): 2265-2274.

Lapointe, M.F., Bergeron, N.E., Berube, F., Pouliot, M.A., Johnston, P. 2004. Interactive effects of substrate sand and silt contents, redd-scale hydrolic gradients, and interstitial velocities on egg-to-emergence survival of Atlantic salmon (Salmo salar). Canadian Journal of Fisheries and Aquatic Sciences 61:2271-2277.

Lindley, S.T., Schick, R.S., Mora, E., Adams, P.B., Anderson, J.J., Greene, S., Hanson, C., May, B.P., McEwan, D.R., MacFarlane, R.B., Swanson, C., Williams, J.G. 2007. Framework for

assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin basin. San Francisco Estuary and Watershed Science 5(1).

Lindley, S.T., Grimes, C.B., Mohr, M.S., Peterson, W., Stein, J., Anderson, J.T., Botsford, L.W., Bottom, D.L., Busack, C.A., Collier, T.K., Ferguson, J., Garza, J.C., Grover, A.M., Hankin, D.G., Kope, R.G., Lawson, P.W., Low, A., MacFarlane, R.B., Moore, K., Palmer-Zwahlen, M., Schwing, F.B. , Smith, J., Tracy, C., Webb, R., Wells, B.K., Williams, T.H. 2009. What caused the Sacramento River fall Chinook stock collapse?Report to the Pacific Fishery Management Council.

Martin, C.D., Gaines, P.D., Johnson, R.R. 2001. Estimating the abundance of Sacramento River juvenile winter Chinook salmon with comparisons to adult escapement. Red Bluff Research Pumping Plant Report Series, Volume 5. U.S. Fish and Wildlife Service, Red Bluff, CA.

Merz J, Caldwell L, Beakes M, Hammersmark C,Sellheim K. 2018. Balancing competing lifestage requirements in salmon habitat rehabilitation: between a rock and a hard place. Restoration Ecology DOI: 10.1111/rec.12900.

Munoz, N. J., A.P. Farrell, J.W. Heath, and B.D. Neff. 2014. Adaptive potential of a Pacific salmon challenged by climate change. Nature Climate Change 5: 163-166.

Murray, C.B., McPhail, J.D. 1988. Effect of incubation temperature on the development of five species of Pacific salmon (Oncorhynchus) embryos and alevins. Canadian Journal of Zoology 66:266-273.

National Marine Fisheries Service. 2014. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. California Central Valley Area Office. July 2014.

National Marine Fisheries Service (NMFS). 2016. 5-year status review: summary and evaluation of Sacramento River winter-run Chinook salmon ESU. NMFS West Coast Region, December 2016.

National Marine Fisheries Service (NMFS). 2017. Endangered Species Act Section 9(a)(2) Biological opinion for the Issuance of an ESA Section 10(a)(1)(A) enhancement permit to the United States Fish and Wildlife Service for implementation of two hatchery and genetic management plans at Livingston Stone National Fish Hatchery. NMFS consultation number: WCR-2016-4012.

O'Farrell, M, Hendrix, N., Mohr, M. 2016. An evaluation of preseason abundance forecasts for Sacramento River winter Chinook salmon. National Marine Fisheries Service, Santa Cruz, CA, October 3, 2016.

Poletto, J.B., Cocherell, D.E., Baird, S.E., Nguyen, T.X., Cabera-Stagno, V., Farrell, A.P., Fangue, N.A. 2017. Unusual aerobic performance at high temperatures in juvenile Chinook

salmon, Oncorhynchus tshawytscha. Conservation Physiology https://doi.org/10.1093/conphys/cow067.

Poytress, W.R., Gruber, J.J., Carrillo, F.D., Voss, S.D. 2014. Compendium report of Red Bluff Diversion Dam rotary trap juvenile anadromous fish production indices for years 2000-2012. Report of U.S. Fish and Wildlife Service to California Department of Fish and Wildlife and U.S. Bureau of Reclamation.

Quinn, T.P., Bloomberg, S. 1992. Fecundity of Chinook salmon (Oncorhynchus tshawytscha) from the Waitaki and Rakaia rivers, New Zealand. New Zealand Journal of Marine and Freshwater Research 1992:429-434.

Roni, P., Johnson C., De Boer, T., Pess, G., Dittman, A., Sear D. 2015. Interannual variability in the effects of physical habitat and parentage on Chinook salmon egg-to-fry survival. Canadian Journal of Fisheries and Aquatic Sciences 73:1-13.

Rubin, J.F. 1995. Estimating the success of natural spawning salmonids in streams. Journal of Fish Biology 46:603-622.

Sapin, J. R. 2014. Impacts of reservoir operations with extreme hydrologic and climatic conditions on fish sustainability below Shasta Lake. University of Nevada, Reno. M.S. Thesis.

Stillwater Sciences. 2007. Sacramento River Ecological Flows Study: Gravel study final report. December 21 2007.

Teffer, A.K., Bass, A.L., Miller, K.M., Patterson, D.A., Juanes, F. and Hinch, S.G., 2018. Infections, fisheries capture, temperature, and host responses: multistressor influences on survival and behaviour of adult Chinook salmon. Canadian Journal of Fisheries and Aquatic Sciences, 75(11), pp.2069-2083.

Terhune, LDB. 1958. The Mark IV groundwater standpipe for measuring seepage through salmon spawning gravel. J Fish. Res. Bd. Canada, 15(5): 1027-1063.

Tonina, D and JM Buffington. 2009. A three-dimensional model for analyzing the effects of salmon redds on hyporheic exchange and egg pocket habitat. Canadian Journal of Fisheries and Aquatic Sciences 66:2157-2173.

United States Fish and Wildlife Service (USFWS). 1999. Effect of temperature on early-life survival of Sacramento River fall-and winter-run Chinook salmon. Final report, Jan. 1999.

Vogel, D. A., and K. R. Marine. 1991. Guide to upper Sacramento River Chinook Salmon life history. Prepared by CH2M Hill for the U.S. Bureau of Reclamation, Central Valley Project, Redding, California.

Voss, SD and W.R. Poytress. 2020. Brood year 2018 juvenile salmonid production and passage indices at Red Bluff Diversion Dam. USFWS report to USBR. August 2020.

Willis, A.D., Nichols, A.L., Jeffres, C.A. and Deas, M.L., 2013. Water resources management planning: Conceptual framework and case study of the Shasta basin. National Fish and

Wildlife Foundation, Davis, CA. Accessed 5-27-2022 online at: https://watershed.ucdavis.edu/files/biblio/Shasta%20Basin%20Planning%20Framework%2010-23-2013.pdf.

Zeug, S.C., L.K. Albertson, H.S. Lenihan, J. Hardy & B. Cardinale. 2011. Predictors of Chinook population extirpations in the Central Valley of California. Fisheries Management and Ecology. 18:61-71.

Zeug, S.C., P.S. Bergman, B.J. Cavallo and K.S. Jones. 2012. Application of a life cycle simulation model to evaluate impacts of water management and conservation actions on an endangered population of Chinook Salmon. Environmental Modeling and Assessment 17:455-467.

Zimmermann AE, Lapointe M. 2005 Intergranular low velocity through salmonid redds: sensitivity to fines infiltration from low intensity sediment transport events. River Res. appl. 21, 865–881.

4.3 MODELS

Caldwell, J., Rajagopalan, B. and Danner, E., 2015. Statistical modeling of daily water temperature attributes on the Sacramento River. Journal of Hydrologic Engineering, 20(5). Accessed 5-27-2022 online at: https://www.researchgate.net/profile/Eric-Danner-2/publication/266373690_Statistical_Modeling_of_Daily_Water_Temperature_Attributes_on_the_Sacramento_River/links/5c6471cc92851c48a9d24b68/Statistical-Modeling-of-Daily-Water-Temperature-Attributes-on-the-Sacramento-River.pdf.

4.4 CLIMATE CHANGE

Ho, P., 2014. Shasta Dam operations and stream temperature sensitivities in response to climate change. M.S. Thesis, California State University, Sacramento. Accessed 5-27-2022 online at: https://scholarworks.calstate.edu/downloads/08612n57q.

5 CONCLUSION

The Water Authority appreciates this opportunity to submit these comments and looks forward to working with Reclamation and others in this process.

Sincerely,

J. Scott Petersen, P.E.
Director of Water Policy
San Luis & Delta-Mendota Water Authority