Master Response 5 Aquatic Biological Resources

Overview

Commenters raised multiple concerns regarding the methods of evaluation, impact analyses, and mitigation measures related to aquatic biological resources. This master response addresses methodological questions and comments about the models and results supporting those analyses (e.g., modeling refinements for the Final EIR/EIS, use of mean values in some results, and monthly data), as well as impact analyses and mitigation measures related to flow effects and smelt impact analyses and associated mitigation measures. In addition, clarification is provided regarding how determinations of significance were made pursuant to CEQA and NEPA requirements, including how baseline conditions are considered in the determinations. Clarification is provided regarding distinctions between CEQA and NEPA requirements and requirements of various permits (e.g., state and federal Endangered Species Act [ESA] requirements, and Clean Water Act (CWA) permitting requirements), which several commenters have conflated with CEQA and NEPA requirements. Topics of discussion in this master response addressing recurring commenter topics and themes include, but are not limited to, the following:

- Methods and use of models and modeled results.
- Uncertainty.
- Special-status fish species and CEQA/NEPA requirements.
- Project benefits to fisheries.
- Flow impacts and mitigation measures.
- Planned adaptability in managing operations and additional studies to address current uncertainties regarding Funks and Stone Corral Creeks
- Longfin smelt and delta smelt impact analyses and associated mitigation measures

This master response includes, for ease of reference, a table of contents on the following page to help guide readers in finding where the topics of their concern are addressed. The table of contents is based on general recurring and common themes found in the comments that were received.

Table of Contents

Use of Best Available Tools

A number of comments expressed concerns that best available information was not used in the RDEIR/SDEIS to assess potential effects on aquatic biological resources. For example, comments suggested that the National Marine Fisheries Service (NMFS) Sacramento River Winter-Run Chinook Salmon Life Cycle Model (WRLCM) be used. Other examples related to best available information are provided below (e.g., with respect to the analysis based on Michel et al. [2021] and longfin smelt–outflow effects).

Some commenters noted that the CALSIM 3 model has recently been publicly released by the California Department of Water Resources (DWR). Please refer to Master Response 3, *Hydrology and Hydrologic Modeling*, for a discussion on the use of CALSIM II.

Several commenters noted that the current modeling was not sufficient to fully illustrate the impacts of the Project on winter-run Chinook salmon survival. Some suggested that the NMFS WRLCM should have been used in the RDEIR/SDEIS instead of the Interactive Object-Oriented Simulation (IOS) and Oncorhynchus Bayesian Analysis (OBAN) winter-run life cycle models that were used. NMFS WRLCM is not generally available because it requires NMFS participation in operating the model, and NMFS resources, which are limited, were not available for the preparation of the RDEIR/SDEIS. Agency practice generally requires use of the best available scientific information. The analytical tools used in the RDEIR/SDEIS were those available to the Authority and Reclamation and practicable for use at the time of document preparation.. IOS and OBAN provide appropriate information because they are based on the peer-reviewed literature and years of field data and have been used in other environmental planning documents for projects related to water supply and water resource planning (e.g., Bay-Delta Conservation Plan, California WaterFix). In addition, related to flow and water temperature, the use of IOS and OBAN is sufficient to meet the planning needs of NEPA and CEQA because these analytical tools provide the relative changes between conditions under the No Project Alternative and conditions under each of the Project alternatives. This provides decision makers with an understanding of the relative change and magnitude of impacts between the No Project Alternative and the Project alternatives, and comparatively between the Project alternatives.

Several commenters noted that the OBAN model does not include a flow-survival relationship and suggested that the NMFS WRLCM be used to evaluate this relationship. For the Final EIR/EIS, the OBAN model incorporates the Michel et al. (2021) flow-survival relationship. The Authority and Reclamation expect to supplement IOS and OBAN analyses by working with NMFS to run the WRLCM for the state and federal ESA permitting processes. The use of this model during permitting will assess the need for conservation measures or conditions that may be included in the federal Section 7 and state incidental take permit (ITP).

Methods and Use of Modeled Results

Use of Daily or Monthly Modeling Results in Analysis

Two river flow models with different time steps were used for analyses of flow-related fisheries effects upstream of the Delta: the CALSIM II operations and flow model and the Upper Sacramento River Daily Operations Model (USRDOM) operations and flow model. CALSIM II provides estimates of mean monthly flow at a number of locations in the Sacramento River and its tributaries, and USRDOM provides estimates of mean daily flow at a more limited number of locations on the Sacramento River, primarily upstream of the Red Bluff Diversion Dam[1].

Two water temperature models were used for analyses of water temperature–related effects upstream of the Delta. The HEC5Q temperature model was used to predict mean daily water temperature at several locations in the Sacramento and American Rivers. The Reclamation Temperature Model was used to predict mean monthly water temperature at multiple locations in the Feather River. No acceptable water temperature model at a daily time-step is currently available for the Feather River. Outputs from both models were used to evaluate the frequency and magnitude of exceedance above several indicator water temperature values at either a daily or monthly time-step depending on the river (see full description in Appendix 11B, *Upstream Fisheries Impact Assessment Quantitative Methods*).

Regarding the proper use of models employed in the RDEIR/SDEIS and interpretation of their results, the following discussion from Appendix 5B, *Water Resources Modeling System*, *Appropriate Use of Modeling Results* section, is particularly useful:

> “The models developed and applied in planning analysis such as the RDEIR/SDEIS impact evaluation, are generalized and simplified representations of a complex water resources system…. A brief description of appropriate use of the model results to compare two scenarios or to compare against threshold values or standards is presented below.
>
> Absolute vs. Relative Use of the Model Results
> The models used in planning analysis are not predictive models (in how they are applied in this Project), and therefore the results cannot be considered as absolute with and within a quantifiable confidence interval. The model results are only useful in a comparative analysis and can only serve as an indicator of condition (e.g., compliance with a standard) and of trend (e.g., generalized impacts).
>
> Appropriate Reporting Time-Step
> Due to the assumptions involved in the input data sets and model logic, care must be taken to select the most appropriate time-step for the reporting of model results. Sub-monthly (e.g., weekly or daily) reporting of model results are generally inappropriate for all models and the results should be presented on a monthly basis. Specific to the

---

[1] The Red Bluff Diversion Dam, which was decommissioned in 2013, and the Red Bluff Pumping Plant are colocated, and the names may be used interchangeably when referring to the geographic location.

> RDEIR/SDEIS, there are exceptions to this guidance, and selected model results can be reported on a sub-monthly basis with adequate caution."

CALSIM II and USRDOM were used for different types of flow-related analyses in the RDEIR/SDEIS. USRDOM results were used for analyses of processes in which daily flow changes potentially have critical effects on the life stage analyzed. These analyses include redd dewatering, juvenile stranding, redd scour, and low-flow passage. In all of these analyses, the most extreme flows that occur over a period of time, rather than the average flows, tend to drive the effect. Monthly average flow results may fail to capture the flow events that produce the effects being analyzed. The redd dewatering and juvenile stranding analyses use the minimum flow over a period of several months, whereas redd scour and low-flow passage analyses use flows that exceed or fall below a threshold flow. For example, in redd dewatering, the minimum flow over a 3-month period of egg and alevin incubation determines the percentage of active redds that are dewatered. Monthly average flows are likely to be more uniform over the 3 months, while daily flows could fluctuate greatly, resulting in high levels of redd dewatering. No daily flow model is available for the Feather or American Rivers, so CALSIM II flow data were used for all analyses in these rivers. As noted in Appendix 11N, *Other Flow-Related Upstream Analyses*, the use of monthly time-step flow estimates likely underestimates Project effects, but this potential bias is expected to affect all alternative scenarios equally.

Table MR5-1 provides an example to demonstrate how results of redd dewatering analyses using USRDOM versus CALSIM II can differ. Percentages of spring-run and fall-run Chinook salmon redds dewatered in the Clear Creek reach of the Sacramento River for the No Action Alternative (NAA[2]) and Alternative 3 were computed using the USRDOM and CALSIM II flow estimates for the Sacramento River at the Clear Creek confluence with the fall-run/spring-run redd dewatering matrix provided in Appendix 11N. The spawning and incubation periods extend from August through January for spring-run Chinook salmon and from September through February for fall-run Chinook salmon. As expected, the results show higher percentages of redds dewatered for computations using USRDOM daily flows as compared to those computed from CALSIM II monthly flows, with a few exceptions. The average differences between the CALSIM II and USRDOM results for both the NAA and Alternative 3 are about 15%. Note, however, that the results show little difference in the change in redd dewatering from NAA to Alternative 3. All changes in percentages of redds dewatered greater than 2% are highlighted and flagged in the table, with green and an asterisk (*) used for reductions and blue and a caret (^) for increases. These results show that using USRDOM for redd dewatering computations provides better estimates of the magnitude of dewatering, but that the two models provide similar estimates for comparing Project effects.

---

[2] The term *NAA or No Action Alternative*, which is identical to the No Project Alternative, is used throughout Master Response 5, as well as Chapter 11, *Aquatic Biological Resources*, and associated aquatic resources appendices in the presentation of modeled results and represents no material difference from the No Project Alternative, as discussed in Chapter 3, *Environmental Analysis*.

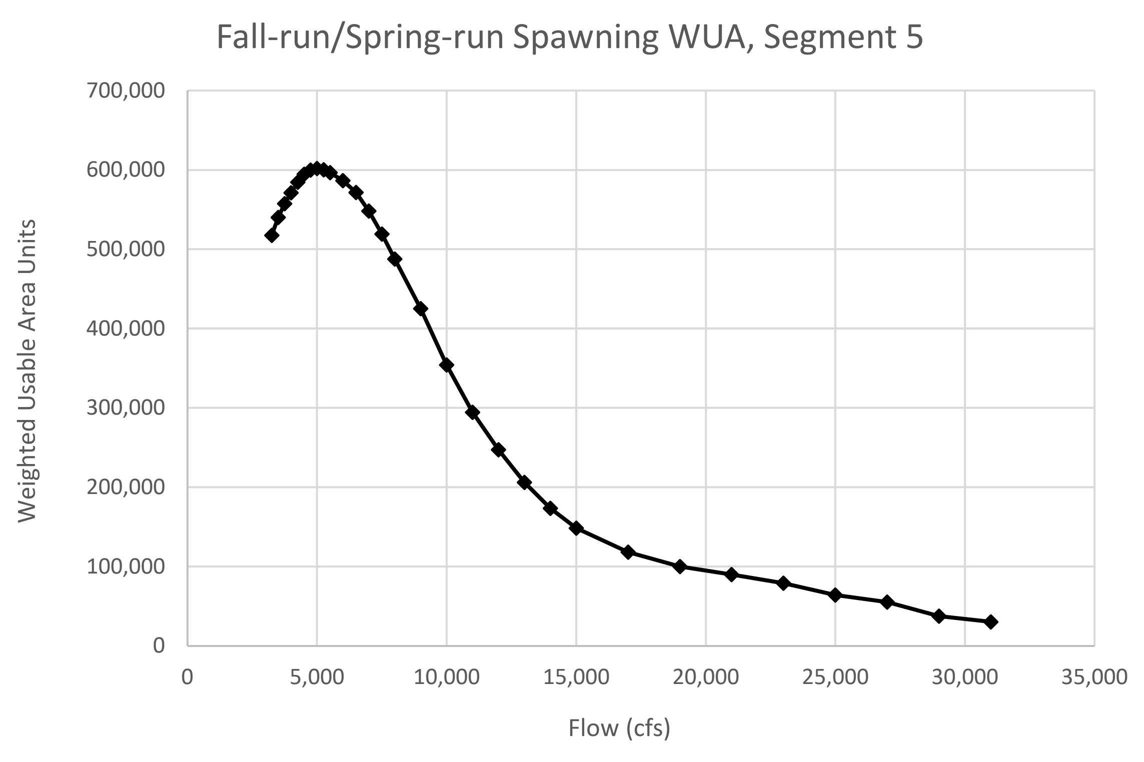
Table MR5-1. Comparing Percentage of Redds Dewatered for Clear Creek Reach Averaged Over Months (CALSIM II Results) and Days (USRDOM Results) for Spring-Run (August through October) and Fall-Run (September through November) Chinook Salmon

		CALSIM II Results			USRDOM Results		
Month	**Water Year Type**	**NAA**	**Alt 3**	**Difference**	**NAA**	**Alt 3**	**Difference**
August–November	Wet	17	17	0.3	23	23	0.1
	Above Normal	17	10	-6.7 *	22	16	-5.9 *
	Below Normal	22	17	-5.2 *	27	23	-3.4 *
	Dry	25	24	-0.7	27	27	0.2
	Critically Dry	20	21	0.9	21	23	2.2 ^
	All	20	18	-1.7	24	23	-1.0
September–December	Wet	22	22	0.0	26	26	-0.5
	Above Normal	22	22	0.3	20	21	1.2
	Below Normal	6	3	-2.5 *	8	6	-2.2 *
	Dry	2	3	0.1	5	5	-0.1
	Critically Dry	3	5	1.9	6	8	1.6
	All	12	12	-0.1	14	14	-0.2
October–January	Wet	8	9	0.7	12	13	1.1
	Above Normal	9	9	-0.3	12	12	0.0
	Below Normal	14	15	1.2	13	14	1.1
	Dry	14	16	1.7	12	14	1.6
	Critically Dry	12	13	0.5	11	11	0.5
	All	11	12	0.8	12	13	1.0
November–February	Wet	11	12	0.8	12	12	0.0
	Above Normal	7	8	0.5	10	10	0.5
	Below Normal	13	13	0.8	11	11	0.0
	Dry	20	21	1.7	16	16	0.4
	Critically Dry	13	16	2.5 ^	12	13	1.3
	All	13	14	1.2	12	13	0.4

Alt = alternative; NAA = No Action Alternative.

Note: Cells with differences greater than 2% are highlighted. Green shading with an asterisk (*) is used for reductions, and blue shading with a caret (^) is used for increases.

CALSIM II results were used for analyses in which information on daily variations in flow was not considered essential. With regard to upstream flow-related effects, CALSIM II was used primarily for computations of spawning and rearing habitat weighted usable area (WUA) of Chinook salmon and steelhead. WUA analyses are based on predetermined relationships between the availability (weighted surface area) of suitable habitat and river flow. Figure MR5-1 provides an example of the WUA versus flow curve used for fall-run and spring-run Chinook salmon in a reach of the Sacramento River from the Anderson-Cottonwood Irrigation District Dam to Cow Creek. For this reach, WUA was estimated from the WUA curve in Figure MR5-1 for CALSIM II flows at two locations, Keswick Dam and the Clear Creek confluence, and the WUA estimates for the two locations were averaged. Note that for both models, the flow data are those developed for the Final EIR/EIS. As noted above, daily flows often vary greatly from the mean monthly flow. However, the mean WUA estimated from all daily flows is expected to be roughly equal to the WUA estimated from the monthly flow, as discussed below.



cfs = cubic feet per second; WUA = weighted usable area.

Figure MR5-1. Spawning Weighted Usable Area for Fall-Run and Spring-Run Chinook Salmon in the Sacramento River near Clear Creek

Table MR5-2 provides an example for spring-run and fall-run spawning WUA to demonstrate how results of WUA analyses using CALSIM II monthly flows give similar results to those using USRDOM daily flows. Spring-run spawn from August through October, and fall-run spawn from September through November. WUAs for the NAA and Alternative 3 were computed using the WUA curve in Figure MR5-1 with flows for the Sacramento River at Keswick Dam and the Clear Creek confluence from the two flow models. The flow data for both models are those developed for the Final EIR/EIS. The results show roughly similar estimates for mean spawning WUA as computed from CALSIM II monthly flows and USRDOM daily flows, with similar patterns of change over months and water year type. The average differences between the CALSIM II and USRDOM results for the NAA is 2% for both the NAA and the Alternative 3 results. More importantly, for the effects analysis, the results show little difference in the percent change from NAA to Alternative 3. All percent changes greater than 5% are highlighted and flagged in the table, with green and an asterisk (*) used for increases and blue and a caret (^) for reductions.

Table MR5-2. Comparison of Mean Spawning Weighted Usable Area for Segment 5 Averaged Over Months (CALSIM II Results) and Days (USRDOM Results) for Spring-Run (August through October) and Fall-Run (September through November) Chinook Salmon

		CALSIM II Results			USRDOM Results		
Month	**Water Year Type**	**NAA**	**Alt 3**	**Percent Difference**	**NAA**	**Alt 3**	**Percent Difference**
August	Wet	304,211	307,390	1.04	286,654	291,568	1.71
	Above Normal	327,693	379,247	15.73 *	308,713	359,390	16.42 *
	Below Normal	379,219	404,993	6.80 *	362,638	386,815	6.67 *
	Dry	418,461	426,104	1.83	401,349	408,612	1.81
	Critically Dry	496,854	470,674	-5.27 ^	487,676	463,946	-4.87
	All	373,724	384,524	2.89	357,450	368,673	3.14
September	Wet	336,337	341,210	1.45	336,439	341,094	1.38
	Above Normal	433,155	427,314	-1.35	429,575	425,591	-0.93
	Below Normal	585,357	587,175	0.31	576,883	579,188	0.40
	Dry	590,677	589,959	-0.12	586,510	585,920	-0.10
	Critically Dry	583,945	587,629	0.63	588,236	587,384	-0.14
	All	485,087	486,469	0.28	482,862	483,894	0.21
October	Wet	519,668	506,988	-2.44	524,154	513,711	-1.99
	Above Normal	541,655	539,602	-0.38	548,038	545,392	-0.48
	Below Normal	551,329	546,684	-0.84	555,844	550,580	-0.95
	Dry	571,375	562,916	-1.48	576,425	567,243	-1.59
	Critically Dry	554,324	554,715	0.07	561,898	561,056	-0.15
	All	544,713	537,800	-1.27	550,057	543,321	-1.22
November	Wet	501,592	496,155	-1.08	546,724	540,021	-1.23
	Above Normal	553,965	543,855	-1.83	572,020	558,852	-2.30
	Below Normal	561,191	559,029	-0.39	574,219	572,562	-0.29
	Dry	529,073	524,085	-0.94	557,389	552,410	-0.89
	Critically Dry	572,150	571,114	-0.18	575,055	572,424	-0.46
	All	535,790	530,971	-0.90	561,607	555,794	-1.04

Alt = alternative; NAA = No Action Alternative.

Note: Cells with percent differences greater than 5% are highlighted. Green shading with an asterisk (*) is used for increases, and blue shading with a caret (^) is used for reductions.

Thresholds and Criteria Used in Analyses

The results of many aquatic biological resource analyses in the RDEIR/SDEIS in Chapter 11, *Aquatic Biological Resources*, and associated appendices, including water temperature, river flow, habitat WUA, redd dewatering, and juvenile stranding, used threshold values to flag differences between the Project alternatives and the NAA. The flagged differences were typically provided in tables of results for each Project alternative. The most often used threshold value was 5% because for most of the results most differences between the NAA and the Project alternatives are less than 5%. For other results, threshold values of 2% or 10% were used. The results were highlighted only to help readers locate the largest differences between the NAA and the Project alternatives. Results showing greater than the threshold increases and reductions from the NAA to a Project alternative were flagged by highlighting the result in green or red, depending on whether the difference was considered potentially beneficial or harmful. For most results, the criteria were not meant to be understood as statistical or biological thresholds of significance for CEQA/NEPA purposes. Some commenters erroneously concluded that the thresholds were used to distinguish actual effects from model noise and to inform impacts determinations in the RDEIR/SDEIS. In fact, impact determinations were not based on any fixed noise threshold. Section 11.3.2, *Operations*, in Chapter 11 of the RDEIR/SDEIS referred to such a noise threshold. This discussion has been removed from the Final EIR/EIS because it was not accurate. The practice of highlighting results in the tables was discontinued for most results in preparing the FEIR/FEIS because of the confusion the created for many commenters.

For tables reporting results as percentages, such as percentage of redds dewatered (Appendix 11N tables titled *Percent of Winter-run Redds Dewatered in the Sacramento River and Differences in the Percentages for the No Action Alternative (NAA) and Alternatives 1–3* through *Percent of Steelhead Redds Dewatered in the American River and Differences in the Percentages for the No Action Alternative (NAA) and Alternatives 1–3*), the absolute differences between the percentage of redds dewatered under the NAA versus the Project alternatives are reported rather than the relative differences (% differences) because computing relative differences of low values often leads to very high values that are not useful for making comparisons. In these tables, the differences are presented without a "%" symbol to indicate that the values are absolute differences rather than percent differences. In the redd dewatering tables, differences greater than 2% in the percentages of redds dewatered between the NAA and the Project alternatives are highlighted because there are very few results with differences greater than 5.

The effects of the Project alternatives on fish and fish populations were evaluated in the EIR/EIS by qualitatively weighing all relevant analysis results, including results from different processes and results from different times and locations. For example, effects of the Project on spring-run Chinook salmon eggs and alevins were evaluated by considering results of analysis of spring-run spawning WUA, redd dewatering, and water temperatures in up to three different locations on the Sacramento River downstream of Keswick Reservoir and during three primary spring-run spawning months. However, the judgment of fisheries experts is necessary to interpret these analyses in the context of all relevant information to support appropriate conclusions regarding the effects of the alternatives on spring-run spawning specifically and on the spring-run population in the Sacramento River overall. Another example of the role of expert judgment is the analyses or effects to longfin smelt (Impact FISH-9) within the Delta. Mitigation was found necessary to reach a CEQA conclusion of less than significant with mitigation for longfin smelt even though the main results of analyses relating indices of abundance to Delta outflow or X2 generally showed only small but uncertain negative effects of the Project compared to the NAA. In light of that uncertainty, expert judgement was necessary to consider results of all longfin smelt analyses and reach an impact determination. Additional discussion of uncertainty in the evaluation of effects is included in the *Uncertainty* section below.

Table MR5-3 (reproduced from Appendix 11N in the RDEIR/SDEIS) provides an example to demonstrate the limitations of basing conclusions about Project effects on a single result. Note that for tables such as Table MR5-3 that report results of percentages (e.g., percentage of redds dewatered), the absolute differences between the percentages under the NAA versus the Project alternatives are reported rather than the relative differences (% differences) because computing relative differences of low values often leads to very high values that are not useful for making comparisons. In these tables, the differences are presented without a "%" symbol to indicate that the values are absolute differences rather than percent differences. In all redd dewatering tables in the RDEIR/SDEIS, differences greater than 2% in the percentages of redds dewatered between the NAA and the Project alternatives were highlighted because there are very few results with differences greater than 5. Note that the results presented in Table MR5-3 have been updated for the Final EIR/EIS based on new CALSIM II results, with cell highlighting eliminated as discussed above.

Table MR5-3. Percent of Spring-Run Chinook Salmon Redds Dewatered in the Sacramento River and Differences in the Percentages for the No Action Alternative and Alternatives 1–3

Period	Water Year Type	NAA	Alt 1A	Alt 1B	Alt 2	Alt 3
August–November	Wet	21.3	20.6 (-0.7)	20.9 (-0.4)	20.6 (-0.7)	20.8 (-0.5)
	Above Normal	20.5	21.3 (0.8)	20.5 (0)	21.3 (0.8)	16.9 (-3.6)*
	Below Normal	24.3	25.3 (1)	24.6 (0.3)	25.3 (1.1)	23.1 (-1.2)
	Dry	27.2	27.6 (0.4)	27.4 (0.2)	27.6 (0.4)	26.1 (-1.2)
	Critically Dry	23.1	21.7 (-1.4)	22.2 (-0.8)	22.7 (-0.3)	22.4 (-0.7)
	All	23.3	23.2 (-0.1)	23.1 (-0.1)	23.4 (0.1)	22 (-1.2)
September–December	Wet	25.6	25.6 (0)	25.6 (0)	25.6 (0)	25.5 (-0.1)
	Above Normal	16.2	16.8 (0.6)	18.5 (2.3)^	16.8 (0.6)	20.7 (4.5)^
	Below Normal	6.9	7.6 (0.7)	7.4 (0.5)	7.6 (0.7)	6.9 (0)
	Dry	5.0	6.1 (1.1)	5.3 (0.3)	6.1 (1.1)	5 (0)
	Critically Dry	6.1	7.3 (1.2)	7.1 (1)	7.3 (1.2)	7.1 (1)
	All	13.7	14.3 (0.6)	14.3 (0.6)	14.3 (0.6)	14.4 (0.8)
October–January	Wet	19.3	19.2 (0)	19 (-0.2)	19.2 (0)	19.1 (-0.2)
	Above Normal	13.9	14.2 (0.3)	14.4 (0.5)	14.2 (0.3)	16.1 (2.2)^
	Below Normal	11.9	11.8 (-0.1)	11.9 (0)	11.9 (0)	12 (0)
	Dry	7.9	8 (0.1)	7.1 (-0.8)	8.1 (0.2)	7.7 (-0.2)
	Critically Dry	8.4	13 (4.6)^	11.6 (3.2)^	11.5 (3.1)^	11.4 (3)^
	All	13.2	13.8 (0.7)	13.4 (0.3)	13.7 (0.5)	13.8 (0.7)

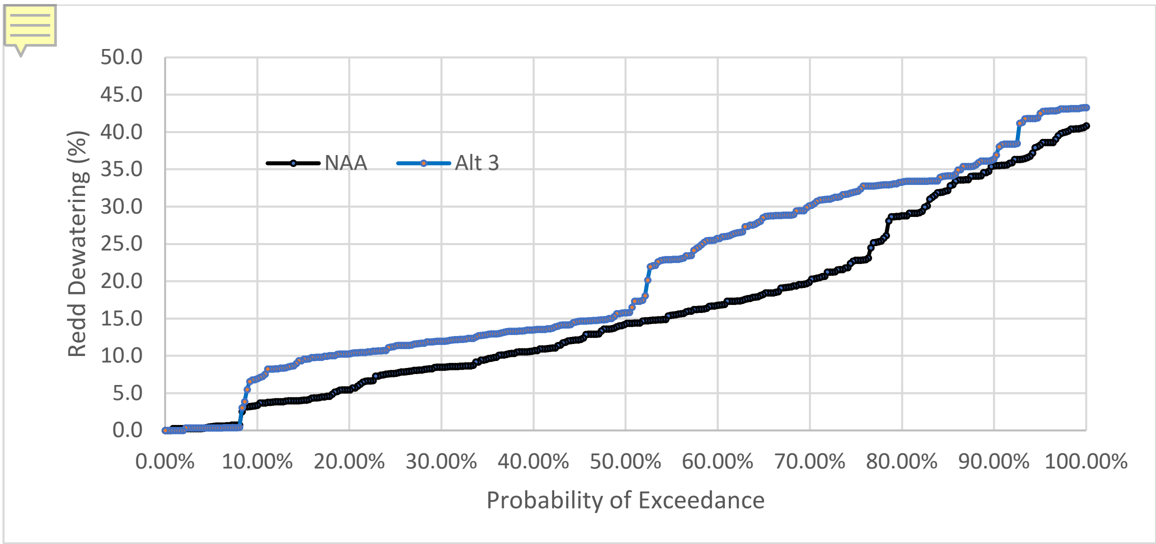
Alt = alternative; NAA = No Action Alternative.

* Results for which redds dewatered under Alternative 1, 2, or 3 are more than 2% below redds dewatered under the NAA are highlighted green.

^ Results for which redds dewatered under Alternative 1, 2, or 3 are more than 2% above redds dewatered under the NAA are highlighted red.

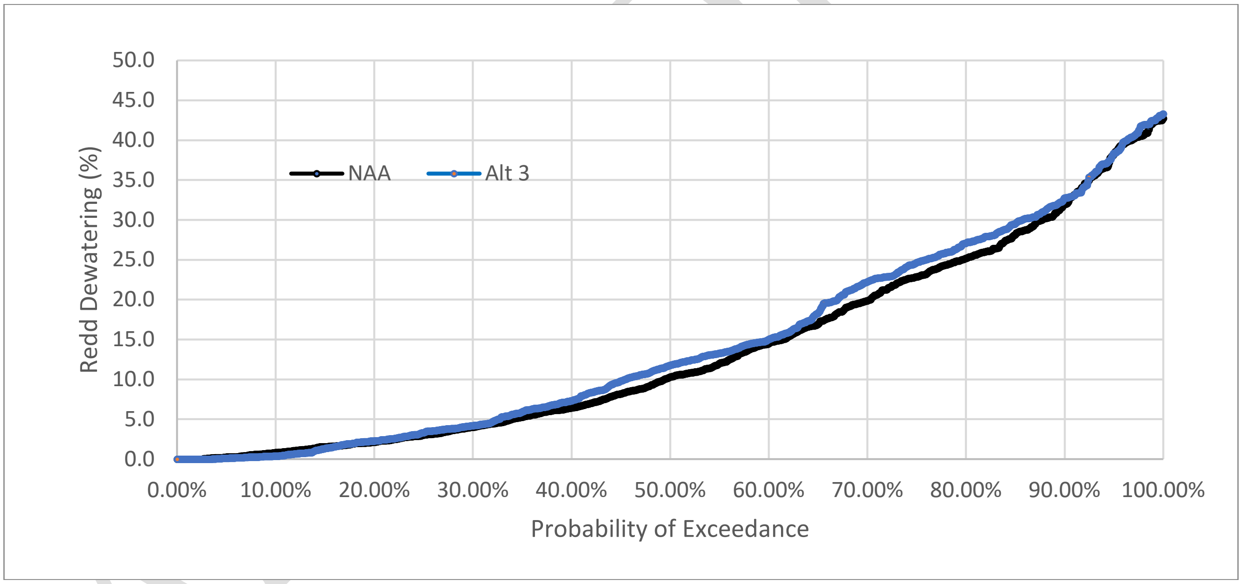
Some commenters stated that the larger differences in the table were too readily dismissed in the RDEIR/SDEIS as not having a substantial effect. The 4.5 increase in percent of spring-run redds dewatered under Alternative 3 in September of Above Normal Water Years, highlighted in the table above, is an example of such a result given by a commenter. As noted above, however, conclusions regarding effects in the EIR/EIS (including both the RDEIR/SDEIS and Final EIR/EIS) are based on all results of analyses. Taking all the results in the table into consideration, rather than just one result, provides a more complete understanding of the effect of an alternative on spring-run redd dewatering.

The differences in conclusions that stem from looking at larger sets of results is best understood by viewing exceedance plots of the results under various groupings (see Figures MR5-2, MR5-3, and MR5-4).The exceedance plot shown in Figure MR5-2 provides all the data used to compute the mean and differences in the highlighted cell described above for Alternative 3 during September in Above Normal Water Years (i.e., “20.7 (4.5)”). Each curve (one for NAA and one for Alternative 3) consists of the results for 330 individual redd dewatering estimates. The curves show that, as expected for any mean, differences between the curves are both larger (up to 10.3) and smaller (-0.03) than the mean difference (4.5) provided in the table. The exceedance plot in MR5-3 shows all the individual results used to compute the means for the five Water Year types in September under Alternative 3. This plot shows that when the full range of flow conditions is considered, differences in redd dewatering between Alternative 3 and the NAA are much smaller, although redd dewatering continues to be somewhat greater under Alternative 3. The plot in MR5-4 gives all the redd dewatering results for the spring-run spawning season, August through October. This plot shows that, when all flow conditions in the entire spawning season are considered, there are essentially no differences in redd dewatering between Alternative 3 and the NAA. This example demonstrates that, while results in individual months and Water Year types may have relatively large differences, the full range of conditions that the fish population is expected to experience must be considered in evaluating effects of a Project alternative on a life history stage. In this example, in addition to including all months and Water Year types, the evaluation of effects on the spring-run population needs to include other factors (e.g., spawning WUA and water temperature), other locations if available, and the other life stages of the species.



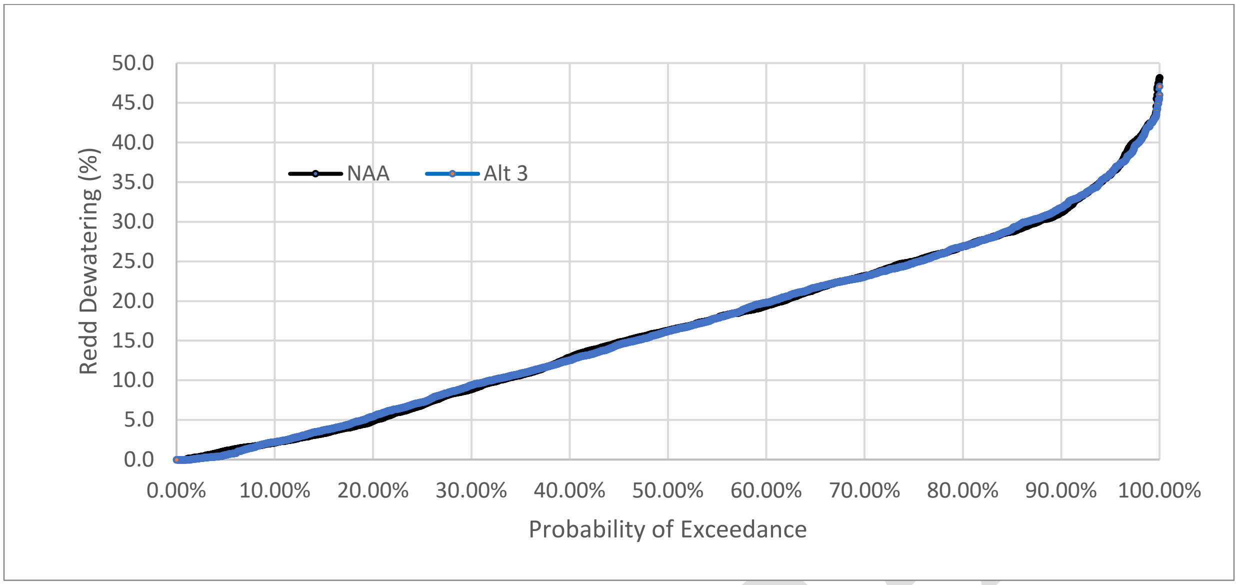
Alt = alternative; NAA = No Action Alternative.

Figure MR5-2. Probability of Exceedance of Spring-run Redd Dewatering, Alternative 3, in September of Above Normal Water Years, Based on RDEIR/SDEIS Results



Alt = alternative; NAA = No Action Alternative.

Figure MR5-3. Probability of Exceedance of Spring-run Redd Dewatering, Alternative 3, in September of All Water Years, Based on RDEIR/SDEIS Results



Alt = alternative; NAA = No Action Alternative.

Note the following important consideration in interpreting the results of the exceedance plots: the values of the two curves at the same probability of exceedance level do not necessarily correspond to results from the same date. Such a presentation is consistent with the goals of the modeling, which include using many dates to obtain a full range of flow or flow-related conditions.

Figure MR5-4. Probability of Exceedance of Spring-run Redd Dewatering, Alternative 3, in August–October of All Water Years, Based on RDEIR/SDEIS Results

Uncertainty

Uncertainty in the impact analysis results is not unique to the Project. This uncertainty stems from several sources, including, but not limited to, variation within the natural environment, inherent uncertainties in modeling, and inconsistent results among the research conducted by the scientific community.

Uncertainty in interpreting modeling results arises from the difficulty in distinguishing differences in results between the NAA and Alternatives 1, 2, and 3 caused by Project effects from those due to random variation. The problem is that the random variation in these circumstances is not well understood, and, therefore, probabilities cannot be assigned with any confidence to different levels of differences in the results. In a formal statistical analysis setting, assumptions are made (and tested) regarding the underlying probability distribution of the random variation, and this information is used to assign probabilities to different levels of observed differences. However, the flow and biological models used for the EIR/EIS effects analyses are complex, with variable constituent parts. These complications and unknowns make quantifying random variation difficult and uncertain.

CEQA and NEPA regulations recognize that some level of uncertainty in results and conclusions regarding determination of Project effects in an EIR and EIS is generally inevitable. CEQA requires a lead agency to determine whether a project may have a significant effect on the environment based on substantial evidence in light of the whole record and further defines substantial evidence as facts, reasonable assumptions predicated on facts, and expert opinion supported by facts. The predictive power of the statistical relationships used to determine the effect of the Project is not absolute (i.e., not able to predict an outcome with 100% certainty).) and thus CEQA allows for expert opinion as a criterion when needed to interpret the results. Similarly, NEPA and related case law require a lead agency to make a reasonable effort to minimize uncertainty and to acknowledge the uncertainty that remains.

Here, a more qualitative approach was used as appropriate to differentiate results due to Project effects from those reflecting model noise. Two features of the results were used for this differentiation: the relative magnitude and the frequency of differences. For the relative magnitude, differences in the results between the No Project Alternative and the Project alternatives that were substantially larger than other differences for similar types of analysis were noted. For example, the spawning WUA results for one race of salmon may include substantially larger differences than those for the other races, in which case the most extreme differences would more often be considered to have positive or negative effects on spawning. For frequency of differences, differences in the results that are either positive or negative in most cases were noted. For example, results for juvenile salmonid floodplain habitat show reductions in habitat acreage much more often than increases in acreage during certain months. When both the magnitude of the differences and consistency in one direction overlap, the differences are considered particularly likely to reflect real Project effects. An example showing both properties is the results for fall-run Chinook salmon juvenile rearing habitat WUA in the Sacramento River upstream of Battle Creek, especially during May and June (Appendix 11K, table titled *Fall-Run Juvenile Rearing WUA*[1] *in the Sacramento River, Segment 4, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3*). Results with such properties are not necessarily considered to show a significant Project effect because conclusions regarding significance of Project effects are based on the net total of all effects, including potential benefits and negative effects. For the example of fall-run Chinook salmon juvenile rearing WUA, although the results in the table cited above show a clear benefit, results for juvenile rearing WUA in the other river segments (see two tables preceding the cited table) are more ambiguous, with more similarity in the number and frequency of positive and negative results. Furthermore, results for fall-run Chinook salmon spawning WUA in the Battle Creek river segment show a negative effect for the Project alternatives (Appendix 11K table titled *Fall-Run Spawning WUA*[1] *in the Sacramento River, Segment 4, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3*). Results for other fall-run Chinook salmon life stages and habitats include both benefits and negative effects, although none of these are as unambiguous as those in the cited table. Additional discussion of analysis thresholds and criteria is included in the *Thresholds and Criteria Used in the Analyses* section above.

The analysis of upstream water temperature effects on fish species considers differences between the NAA and Project alternatives in the magnitude and frequency of exceedance of modeled water temperatures above specific indicator temperature values obtained from the scientific literature (see Appendix 11B, tables titled *Water Temperature Index Values and Index Ranges Used for Water Temperature Index Value/Range Analyses, Sacramento River* through *Water Temperature Index Values and Index Ranges Used for Water Temperature Index Value/Range Analyses, American River*). As described in Ch 5, *Surface Water Resources*, Section 5.3, *Hydrologic Modeling Methods*, all analyses of Project alternatives are compared to the NAA to accommodate uncertainty in model results. Using the model results in a comparative manner helps reduce the effects of possible model inaccuracies that may be associated with simplifying model procedures and assumptions. In addition, in some cases, more than one indicator value is provided for the same analysis to account for variation in results from the scientific literature (e.g., see winter-run Chinook salmon “Spawning, egg incubation, and alevins” in the Appendix 11B table titled *Water Temperature Index Values and Index Ranges Used for Water Temperature Index Value/Range Analyses, Sacramento River*). Also, multiple models (e.g., Anderson, Martin, SALMOD, and IOS) are all considered for temperature-related impacts on winter-run Chinook salmon eggs (see *Benefits* section above). This “weight of evidence” approach seeks to reduce uncertainty by applying multiple methods to assess the same potential effect.

Uncertainty is also addressed by the commitment to adaptive management (see the discussion of the Sites Reservoir adaptive management plan [AMP] in Chapter 2, *Project Description and Alternatives*, and Appendix 2D, *Best Management Practices, Management Plans, and Technical Studies*, of the Final EIR/EIS). Adaptive management is the process of taking an action, evaluating the outcome of that action, and modifying the action to better align the outcome to the goals and objectives of the action. The AMP describes how adaptive management will occur under the Project, including a description of the scope and process of the AMP, decision making and governance, and funding strategy, as well as a list of key pre-Project uncertainties for initial focus.

Use of Means in Reporting Modeling Results

The results of many aquatic biological resource analyses in the RDEIR/SDEIS, including water temperature, river flow, habitat WUA, redd dewatering, and juvenile stranding, are expressed in terms of the mean values by month and water year type. For instance, Table MR5-3, reproduced from Appendix 11N, gives the mean results for spring-run redd dewatering. The table gives both the overall monthly means, computed for all five water year types combined, and the monthly means for each water year type individually. Several commenters objected to presenting the mean results rather than showing all the values from which the means were computed or providing statistics on the distribution of values. Some of these commenters expressed concern that comparing the results of the Project alternatives and the NAA in terms of their monthly means may “hide” more extreme differences that exist for individual months (under CALSIM II) or days (under USRDOM).

It is acknowledged that using mean values to express results may obscure large differences in the modeling results between the Project alternatives and the NAA. However, the models used for the aquatic biological resource analyses produce large amounts of data, ranging from 10 values per month (for Above Normal Water Years with the monthly CALSIM II model) to 806 values per month (for Wet Water Years with the daily USRDOM model). Means efficiently illustrate the general effects of the Project alternatives under a range of flows or flow-related conditions and are in keeping with appropriate use of CALSIM-based modeling. Differences from means necessarily occur in both positive and negative directions, such that impacts and benefits are equally likely to be obscured and, in most cases, are largely cancelled out. This property of means was demonstrated in Figure MR5-2. This plot provides all the data used to compute the mean and difference in percent of spring-run redds dewatered under Alternative 3 in September of Above Normal Water Years (i.e., "20.7 (4.5)"). Each curve (one for NAA and one for Alternative 3) consists of the results for 360 individual redd dewatering estimates. The curves show that, as expected for any mean, differences between the curves are both larger (up to 10.3) and smaller (-0.03) than the mean difference (4.5) provided in Table MR5-3. Given the range of differences in the underlying data, from -0.03 to 10.3, an increase of 4.5% of redds dewatered is a reasonable estimate of the overall effect on spring-run redd dewatering under Alternative 3 for September of Above Normal Water Years.

One type of result for which using the mean can be problematic is when the mean includes individual values that exceed a biologically significant threshold. For instance, the mean water temperature may be below a critical upper threshold for salmonid egg survival, but some of the daily temperatures that contribute to this mean could be above the threshold. Under such circumstances, the fact that there are also water temperatures well below the mean does not compensate for the threshold-exceeding high temperatures. As discussed in the *Thresholds and Criteria Used in Analyses* section above, the results of most analyses are not evaluated based on biological thresholds because such information is typically not available. However, where such information is available, as for water temperatures for salmonids, the results are evaluated in terms of the thresholds, referred to as "index values" in the RDEIR/SDEIS (see Appendix 11B). Thresholds are also used to evaluate redd scour and low-flow passage obstructions based on frequencies of threshold scouring flows and low flows that potentially obstruct upstream migrations. All such threshold flows were determined from published sources or field observations of resource agency experts (Appendix 11N). For most other analyses, no biologically significant thresholds are known that exist within the range of values predicted by the models. Under these circumstances, the means, using the best available information, provide a simple, efficient, and scientifically robust way to characterize the overall effects of the Project alternatives.

Special-Status Fish Species and CEQA and NEPA Requirements

Baseline and Special-Status Species

The RDEIR/SDEIS and Final EIR/EIS use existing conditions in 2020 to define the CEQA environmental baseline. This 2020 environmental baseline reflects a range of historical hydrologic conditions (e.g., watershed runoff); current physical conditions (e.g., dams); current regulatory operating conditions of the CVP and the SWP; the water rights orders and decisions and water quality criteria from the State Water Resources Control Board (State Water Board); current municipal, environmental, and agricultural water uses; current land uses; and relevant current laws, regulations, plans, and policies. CEQA requires analysis of the No Project Alternative, which represents existing environmental conditions and what would be reasonably expected to occur in the foreseeable future if the Project was not implemented. NEPA requires analysis of the No Action Alternative, which, similarly to the CEQA No Project Alternative, is the projection of current and reasonably foreseeable future conditions without the Project, including the continuation of preexisting, ongoing plans, programs, and operations. This is discussed further in Master Response 2, *Alternatives Description and Baseline*, and Chapter 3, *Environmental Analysis*. The terms *NAA* and *No Action Alternative* are used throughout Master Response 5, as well as Chapter 11, *Aquatic Biological Resources*, and associated aquatic resources appendices in the presentation of modeled results and represents no material difference from the No Project Alternative.

Several commenters suggested that, if under the NAA a special-status species population was declining, it is by definition not self-sustaining, and any adverse effect on its habitat or individuals should result in a significance finding pursuant to CEQA Guidelines section 15065(a)(1).That is not correct. CEQA Guidelines section 15065(a)(1) provides guidance to agencies in deciding whether an action they have under consideration would require the preparation of an EIR. Once a decision is made to proceed with an EIR/EIS, the NAA provides a basis for a comparative analysis of relative change to the environment with or without the project to disclose the impacts of the Project. Under the NAA, special-status species populations may be declining. However, this trend is an existing baseline condition, and it is not a criterion to define a significant impact on a species. The impact analysis is required to describe, either qualitatively or quantitatively, the effect of the Project compared to the NAA (see discussion above regarding thresholds and criteria). A special-status species population may be declining under the NAA; however, as long as the Project is not identified as qualitatively or quantitatively worsening conditions from that of the baseline conditions for the population of a special-status species, the analysis may reasonably conclude impacts may be less than significant or not substantially adverse.

For example, Impact FISH-6 in Chapter 11 assesses the effects of the Project on each life stage of green sturgeon and evaluates potential impacts on green sturgeon survival. Overall, there may be some minor effects on rates of spawning migration and additional exposure of larval fish to the fish screens, but these were determined unlikely to have a significant impact on green sturgeon population. Therefore, Impact FISH-6 concluded that operation of Alternative 1, 2, or 3 would not have a significant impact (CEQA) or substantial adverse effect (NEPA), either directly or through habitat modifications, on green sturgeon. Operations impacts of Alternative 1, 2, or 3 were thus determined to be less than significant, even though green sturgeon was listed based on a presumption of population decline (71 *Federal Register* 17757).

Permitting

The Project will require permits under the CWA, federal and state ESAs, and local permitting authorities. Regulating agencies with permitting responsibilities and actions may rely on the NEPA and CEQA documents for relevant information and to support the issuance of permits by regulating agencies. However, NEPA and CEQA do not presuppose the outcome of permitting processes. NEPA and CEQA do not adopt relevant criteria of permitting processes in determining significance. Specifically, the extent to which a project may "take" a threatened or endangered species or is or is not likely to jeopardize the continued existence of a species are determinations specifically considered under state and federal processes of the respective ESAs, and it is the responsibility of the relevant state and federal agencies to make these determinations through their permitting processes pursuant to their rules and regulations. These determinations are not made pursuant to NEPA and CEQA. For example, if the Project was assessed to have the potential for take of anadromous fish through near-field effects such as entrainment during diversions, but also could have positive effects such as improved river temperature management in drier water years, in a permitting context, this may result in a "May Affect, Likely to Adversely Affect" conclusion, but demonstration of an overall positive effect would indicate the anadromous fish were not being jeopardized.

Project Benefits to Fisheries

Some commenters suggested, without providing supporting evidence, that the Authority and Reclamation are disingenuous in their goal of providing fisheries benefits and that the Project or alternatives evaluated would not provide benefits.

The Project objectives and statement of purpose and need are presented in the *CEQA Objectives and NEPA Purpose and Need* section of Chapter 1, *Introduction*. Components of the objectives of particular benefit to fish populations are bolded below:

- OBJ-2: Provide public benefits consistent with Proposition 1 of 2014 and use Water Storage Investment Program (WSIP) funds to improve statewide surface water supply reliability and flexibility to **enhance opportunities for habitat and fisheries management for the public benefit** through a designated long-term average annual water supply.
- OBJ-3: Provide public benefits consistent with the Water Infrastructure Improvements for the Nation Act by using federal funds, if available, **provided by Reclamation to improve CVP operational flexibility** in meeting CVP environmental and contractual water supply needs and **improving cold-water pool management in Shasta Lake to benefit anadromous fish**.
- OBJ-4: Provide surface water to **convey biomass from the floodplain to the Delta to enhance the Delta ecosystem for the benefit of pelagic fishes[3] in the north Delta (e.g., Cache Slough).**

The purpose and need also incorporates fish benefits, as indicated below in bold.

- **Benefits to anadromous fish by improving CVP operations** consistent with the laws, regulations, and requirements in effect at the time of operation.
- **Incremental Level 4 water supply for CVP Improvement Act refuges.**
- **Delta ecosystem enhancement by providing water to convey food resources.**

A key concept of the Project, as evidenced by the objectives and purpose and need, has been and continues to be providing surface water storage north of the Delta that could improve ecosystems by providing improvements in water supply reliability for fish protection, habitat management, and other environmental water needs (Chapter 1, *Introduction*). The Final EIR/EIS discusses

---

[3] Pelagic fish are species that spend most of their life swimming in the water column, having little contact or dependency with the bottom.

potential benefits to fish in Chapter 11, *Aquatic Biological Resources*. Potential benefits of the Project are further discussed below.

Environmental benefits from the Project are achieved through a number of different mechanisms, including:

- Exchanges with Storage Partners, as described in Chapter 2, *Project Description and Alternatives*, of *the* EIR/EIS (section titled *Operations and Maintenance Common to Alternatives 1, 2, and 3*), which provide enhanced operational flexibility and coordination opportunities between the Project, regulatory agencies, the CVP, and the SWP for achieving species benefits.
- Direct releases from Sites Reservoir either through the CBD and Yolo Bypass (all three alternatives) or directly into the Sacramento River approximately 10.5 river miles upstream of Knights Landing via a pipeline from the terminus of the TC Canal at Dunnigan (Alternative 2).

While direct releases to the Sacramento River are specific to Alternative 2, water released from the terminus of the TC Canal would likely be at ambient temperatures, as disclosed in the EIR/EIS, and is not intended to provide a cooling benefit to the lower river. Instead, temperature-related benefits to anadromous fish are achieved through operational exchanges that are elements common to all three alternatives described and analyzed in the EIR/EIS.

As discussed in Chapter 11, *Aquatic Biological Resources*, benefits to anadromous fish in the upper Sacramento River under all the alternatives derive from exchanges between upstream Storage Partners and Sites Reservoir. This allows Storage Partners to deliver water from Sites Reservoir in exchange for conserving water in upstream reservoirs for use at times and locations that maximize potential benefits to anadromous fish. In the case of Shasta Lake, exchanges allow Reclamation to conserve cold water for use in controlling Sacramento River temperatures below Keswick Dam later into the year, and exchanges provide a source of water for fall flow stability to prevent dewatering of redds and for spring pulse actions. Refined modeling for the Final EIR/EIS indicates that, as a result of improved cold-water pool conditions in Shasta Lake, water temperatures in the Sacramento River would be slightly cooler under Alternatives 1, 2, and 3 relative to the NAA in drier years during summer months. Please see:

- Table titled *Sacramento River below Keswick, No Action Alternative 051422, Monthly Temperature (DEG-F)* through table titled *Sacramento River below Keswick, Alternative 3 051722 minus No Action Alternative 051422, Monthly Temperature (DEG-F)*
- Table titled *Sacramento River at Balls Ferry, No Action Alternative 051422, Monthly Temperature (DEG-F)* through table titled *Sacramento River at Balls Ferry, Alternative 3 051722 minus No Action Alternative 051422, Monthly Temperature (DEG-F)*
- Table titled *Sacramento River at Bend Bridge, No Action Alternative 051422, Monthly Temperature (DEG-F)* through table titled *Sacramento River at Bend Bridge, Alternative 3 051722 minus No Action Alternative 051422, Monthly Temperature (DEG-F)*

- Table titled *Sacramento River at Red Bluff, No Action Alternative 051422, Monthly Temperature (DEG-F)* through table titled *Sacramento River at Red Bluff, Alternative 3 051722 minus No Action Alternative 051422, Monthly Temperature (DEG-F)*
- Tables titled *Sacramento River at Butte City, No Action Alternative 051422, Monthly Temperature (DEG-F)* through table titled *Sacramento River at Butte City, Alternative 3 051722 minus No Action Alternative 051422, Monthly Temperature (DEG-F)*
- Figure titled *Sacramento River below Keswick, Long-Term Average Temperature* through figure titled *Sacramento River below Keswick, September*
- Figure titled *Sacramento River at Balls Ferry, Long-Term Average Temperature* through figure titled *Sacramento River at Balls Ferry, September*
- Figure titled *Sacramento River at Bend Bridge, Long-Term Average Temperature* through figure titled *Sacramento River at Bend Bridge, September*
- Figure titled *Sacramento River at Red Bluff, Long-Term Average Temperature* through figure titled *Sacramento River at Red Bluff, September*
- Figure titled *Sacramento River at Butte City, Long-Term Average Temperature* through figure titled *Sacramento River at Butte City, September*

This coincides with the winter-run Chinook salmon spawning, embryo incubation, and alevin period (April through October). As a result of these cooler water temperatures, Martin and Anderson model results (Appendix 11O, *Anderson-Martin Models*) indicate slight reductions in temperature-dependent winter-run egg mortality in drier years under Alternatives 1, 2, and 3 relative to the NAA. This finding for Alternative 3 is further supported by SALMOD (Appendix 11H, *Salmonid Population Modeling (SALMOD)*) results.

The results of rearing WUA analyses indicate that the Project alternatives, especially Alternative 3, would increase WUA of rearing habitat for juvenile-size (>60 millimeter) spring-run, fall-run, and late fall–run Chinook salmon and steelhead in the Sacramento River. The increases in rearing WUA are consistently most pronounced for the reach of the Sacramento River between the Cow Creek and Battle Creek confluences. The results show no effect of the Project alternatives on winter-run Chinook. The juvenile rearing WUA results are provided in Appendix 11K, *Weighted Usable Area Analysis*, tables titled *Winter-run Juvenile WUA*[1] *in the Sacramento River, Segment 6, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3* through *Winter-run Juvenile WUA*[1] *in the Sacramento River, Segment 4, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3*; tables titled *Spring-run Juvenile Rearing WUA*[1] *in the Sacramento River, Segment 6, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3* through *Spring-run Juvenile Rearing WUA*[1] *in the Sacramento River, Segment 4, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3*; tables titled *Fall-run Juvenile Rearing WUA*[1] *in the Sacramento River, Segment 6, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3* through *Fall-run Juvenile Rearing WUA*[1] *in the Sacramento River, Segment 4, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3*; tables titled *Late Fall–run Juvenile*

Rearing WUA[1] *in the Sacramento River, Segment 6, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3* through *Late Fall–run Juvenile Rearing WUA*[1] *in the Sacramento River, Segment 4, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3*; and tables titled *Steelhead Juvenile Rearing WUA*[1] *in the Sacramento River, Segment 6, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3* through *Steelhead Juvenile Rearing WUA*[1] *in the Sacramento River, Segment 4, and Percent Differences (in parentheses) between the NAA and Alt 1A, Alt 1B, Alt 2, and Alt 3*.

Within the Delta, benefits may occur from reservoir releases to CBD/Yolo Bypass, which have the potential to enhance food web productivity in the north Delta for delta smelt[4]. As discussed in Impact FISH-8, flows through the Yolo Bypass in August–October in many years would be several hundred cubic feet per second (cfs) under the Project alternatives, compared to around 50 cfs in most years under the NAA.

Direct releases from Sites Reservoir would also benefit CVP Improvement Act refuges north and south of the Delta as Incremental Level 4 Refuge water under Proposition 1 (see Chapter 2, *Project Description and Alternatives*, section titled *Proposition 1 Benefits Common to Alternatives 1, 2, and 3*).

Flow and Mitigation Measures

Commenters expressed concern that Mitigation Measure FISH-2.1 only included the months of March through May and that this would not encompass the full migration period of juvenile migrating salmonids. In the Final EIR/EIS, the Project alternatives' operational criteria now include Wilkins Slough bypass flow criterion of 10,700 cfs from October 1 to June 14, thereby addressing concerns that the juvenile salmonid migration period is not covered by the criteria. Note that, for the Final EIR/EIS, the Wilkins Slough bypass flow criterion is part of the Project and no longer a mitigation measure (see Master Response 2, Alternatives Description and Baseline). Commenters expressed concern that the Sites Reservoir Daily Divertible and Storable Flow Tool did not include analysis of Above Normal Water Years and that the analysis of Wet Water Years in Appendix 11P, *Riverine Flow-Survival*, indicated there would likely be significant impacts in Above Normal Water Years. The Final EIR/EIS includes revised analysis in Appendix 11P, including the October–June 10,700 cfs Wilkins Slough bypass flow criterion, which is now part of Project operational criteria. The analysis shows essentially 0% difference in survival between the Project and the NAA in all of the years analyzed, and the same would be true if Above Normal Water Years were available for inclusion in the data, as a result of the nature of the flow-threshold relationship in the analysis. In addition to the analysis described in Appendix 11P, note that the IOS model includes explicit assessment of Above Normal Water Years for riverine flow-survival based on a different form of statistical relationship, with the results showing little difference (0%–1%) between the Project alternatives and the NAA (see

---

[4] The California Department of Fish and Wildlife (CDFW) recognized this benefit during the WSIP process; see https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2018/WSIP/TechReview/Sites_CDFW_Findings.pdf

further discussion below). Commenters also expressed concern that the analysis of migration flow-survival effect should have been done separately for winter-run Chinook salmon and that it should have included migration months prior to January. In response, the analysis in Appendix 11P was redone for each Chinook salmon run separately and includes the period October–June; as noted above, the analysis shows 0% difference in survival between the Project and the NAA for all years analyzed.

Some comments suggested the flow-threshold approach based on Michel et al. (2021) was inadequate because other studies suggest that juvenile Chinook salmon survival would be reduced by diversions between 10,712 cfs and approximately 20,000 cfs. The studies cited by commenters only examined linear-type relationships between flow and survival, whereas Michel et al. (2021) compared linear-type relationships with step-function (threshold) relationships and found the latter to have better support by the available data, including more years of data than studies such as Henderson et al. (2019) and Hassrick et al. (2022); this has been noted in the Final EIR/EIS. However, the river migration component of the IOS model includes a linear-type flow-survival relationship and therefore provides an illustration of potential effects on winter-run Chinook salmon assuming that type of relationship. As shown in the analysis, the effects are generally limited (differences in mean river survival of 0%–1%; see Impact FISH-2 in the Final EIR/EIS). Comments noted that although Michel et al. (2021) found strong evidence of decreased survival at flows below 10,712 cfs, very few observations were made for flows between 14,000 and 21,000 cfs; comments further suggested that the effects of reducing flow on survival are less certain in this range and speculated that it is quite possible that survival benefits of flows above 10,712 cfs were not detected by Michel et al. (2021). The EIR/EIS focuses on what was found by Michel et al. (2021), rather than speculating on what may have been possible. Commenters noted that the analysis by Michel et al. (2021) was based on juvenile Chinook salmon large enough to carry sonic (acoustic) tags and suggested that Michel et al. (2021) conclusions regarding flow-survival effects may not apply to smaller fish. There have not been similar flow-survival thresholds developed for smaller fish (although see discussion related to Munsch et al. [2020] below), so the best available information is the Michel et al. (2021) threshold included as part of the operational criteria in the Final EIR/EIS. Although commenters provided citations in the context of potential effects on smaller fish (Michel 2019; Notch et al. 2020), neither of these studies addresses smaller fish, and, as noted above, although these authors found continuous (linear-type) flow-survival relationships, they did not examine evidence for threshold-type responses in addition to continuous responses. The AMP includes consideration of in-river flow requirements in light of ongoing research, which could be used to refine the basis of limiting Project diversions, e.g., if flow-survival relationships are found for smaller fish.

Comments noted that Munsch et al. (2020)[5] identified a Sacramento River flow threshold associated with high likelihood of detection of Chinook salmon fry in the Delta and that Munsch et al. (2020) found that abundance of fry increased continuously with increasing flows. The threshold identified by Munsch et al. (2020) for high likelihood of detection and greater abundance of fry was 500 cubic meters of water per second (cumecs) during December through

---

[5] Note that comments actually cited Munsch et al. (2019), but the information cited is instead consistent with information provided by Munsch et al. (2020).

May at Freeport. The CALSIM modeling for the Final EIR/EIS Project alternatives demonstrates that the 10,700 cfs (approximately 300 cumecs) Wilkins Slough bypass flow included in the Project operational criteria effectively ensures that Freeport flows are at least 500 cumecs (Figures MR5-5, MR5-6, MR5-7), thereby limiting the potential for negative effects on Chinook salmon fry distribution and abundance per the analysis by Munsch et al. (2020). Note also that Munsch et al. (2020) found that the likelihood of detection and catch (abundance) when present of Chinook salmon fry was related to short-term Sacramento River flow pulses; the 7-day pulse protection criteria included in the Project operational criteria would also limit the potential for negative effects by this mechanism.

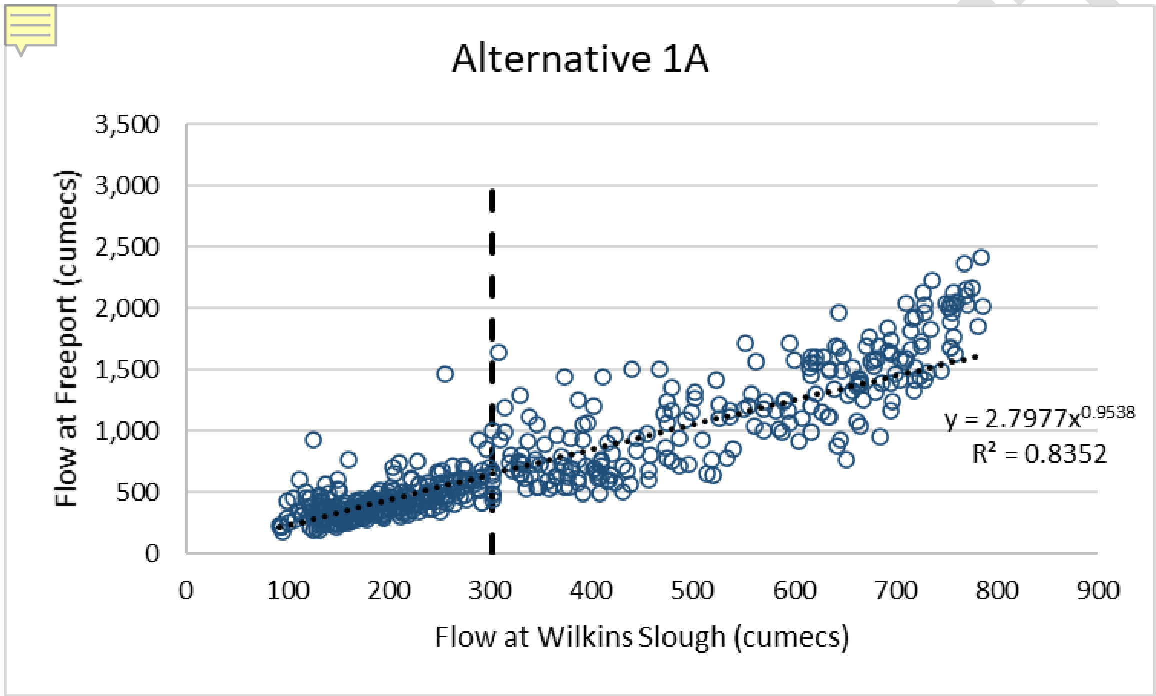


Figure MR5-5. Monthly Mean Flow in the Sacramento River at Freeport as a Function of Monthly Mean Flow in the Sacramento River near Wilkins Slough, December–May 1922–2003, Final EIR/EIS CALSIM Modeling for Alternative 1A

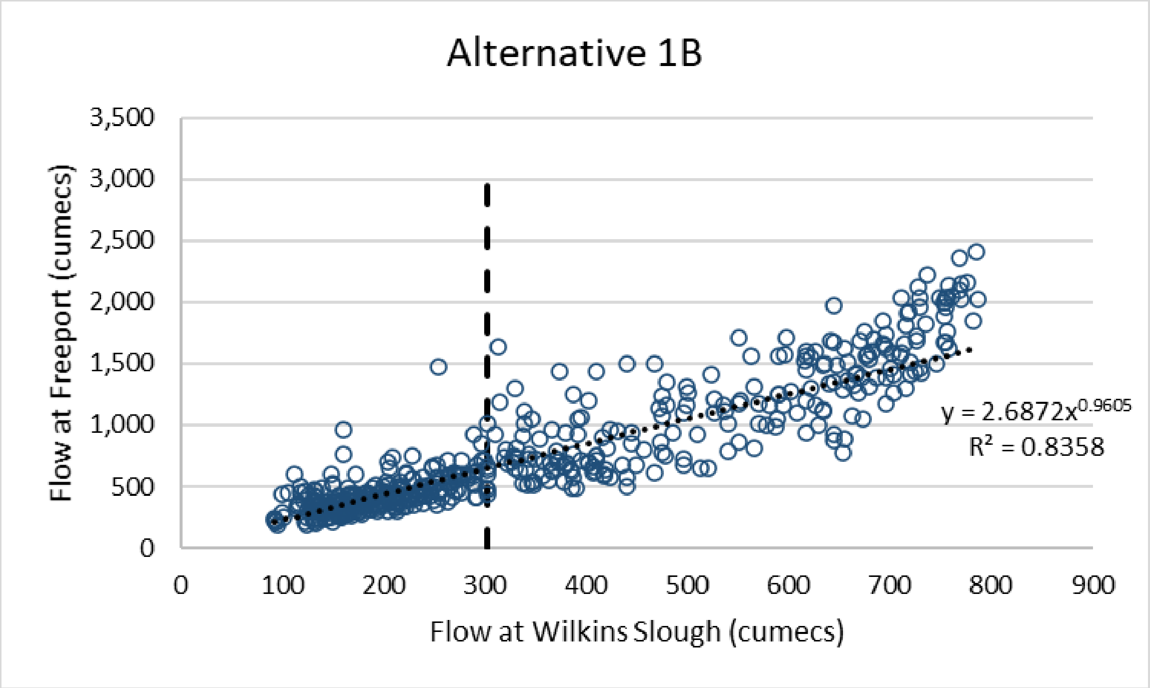


Figure MR5-6. Monthly Mean Flow in the Sacramento River at Freeport as a Function of Monthly Mean Flow in the Sacramento River near Wilkins Slough, December–May 1922–2003, Final EIR/EIS CALSIM Modeling for Alternative 1B

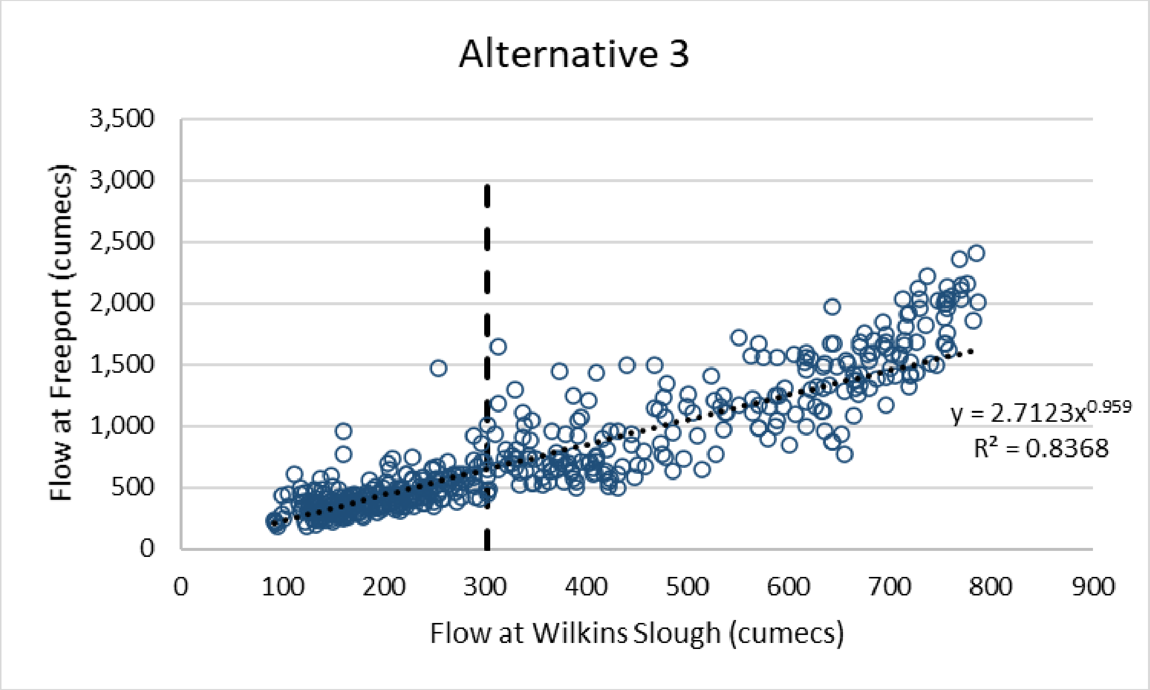


Figure MR5-7. Monthly Mean Flow in the Sacramento River at Freeport as a Function of Monthly Mean Flow in the Sacramento River near Wilkins Slough, December–May 1922–2003, Final EIR/EIS CALSIM Modeling for Alternative 3

With respect to the Wilkins Slough 10,700 cfs bypass flow criterion, commenters suggested that the proposed flow bypass mitigation allows no margin for error and is thus likely to result in frequent loss of real survival benefits ascribed to the flow threshold and that there should be a safety factor incorporated. Commenters suggested that Michel et al. (2021:Figure 4) estimate uncertainty around their flow threshold; in fact, the Michel et al. (2021) Figure 4 examines the statistical evidence for different flow thresholds. The best available information the paper provides is the flow threshold included in the Project alternatives' bypass flow criterion. The Michel et al. (2021) Figure 5 shows there is uncertainty estimated for the survival estimates at each flow range, as opposed to uncertainty related to the flow threshold itself. As described in RDEIR/SDEIS Appendix 2D, *Best Management Practices, Management Plans, and Technical Studies*, technical studies will be undertaken to validate analyses conducted, refine and understand the mechanism(s) by which Project operations affect aquatic resources in high-flow conditions, and explore ways in which Project operations can further benefit fish populations. Specific parameters for each technical study will be developed as part of individual study plans, with the approval of the permitting fish agencies (i.e., NMFS, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife [CDFW]). These parameters may consist of assessing factors such as whether diversion operations have resulted in statistically significant changes in monitored variables (e.g., fish distribution and migration survival).

Commenters expressed concern that the analysis of flow-survival effects in Appendix 11P assumes that the proportion of salmon migrating down the Sacramento River on a daily basis is the same proportion that passed the Red Bluff sampling station, whereas acoustic tag data show varying speeds of migration, and that this could have resulted in the RDEIR/SDEIS failing to accurately analyze the effects of the Project alternatives. The analysis in Appendix 11P is based on the same software code as the peer-reviewed analysis by Michel et al. (2021). Any assumptions regarding the proportion of salmon migrating at a particular time are common to the Project alternatives and the NAA. Note that, in the Final EIR/EIS, the analysis with differing weightings of migration timing is no longer included because the Project alternatives include the 10,700 cfs Wilkins Slough bypass flow criterion and there is essentially no difference from the NAA; therefore, there is no need to demonstrate the effects of different migration proportions.

Commenters expressed concern that the analysis of flow-survival effects in Appendix 11P was focused on fish timing at RBDD rotary screw traps and that this did not represent the timing of juvenile salmonids emigrating from other locations such as downstream of the RBDD. As noted previously, the Wilkins Slough bypass flow criterion of 10,700 cfs is part of the operational criteria and covers the period from October to June, thereby capturing the juvenile salmonid outmigration period that coincides with diversions to Sites Reservoir. This also addresses concerns related to timing of different life stages; concerns expressed by commenters regarding life stages that are rearing (i.e., fry, as opposed to migrating parr and smolts) were addressed in the assessments of potential changes in habitat extent (Appendix 11M, *Yolo and Sutter Bypass Flow and Weir Spill Analysis*). Commenters expressed concerns that the analysis in Appendix 11P did not include impacts on Butte Creek and Feather River origin salmonids that enter the Sacramento River below Wilkins Slough. However, the analysis based on Michel et al. (2021) extends to the mouth of the Feather River, from which point downstream any effects of the Project alternatives would be relatively less because of additional flow joining the main stem

Sacramento River from the Feather River. In addition, the analysis of through-Delta survival based on Perry et al. (2018) provides perspective on the limited effects within the Delta. Combined, these pieces of information indicate limited potential for negative effects on Butte Creek and Feather River juvenile salmonid outmigrants.

The operational criteria included in the Final EIR/EIS based on Michel et al. (2021) for Wilkins Slough bypass flows, in addition to pulse protection criteria, are considered to result in a less-than-significant impact on salmonids in the Final EIR/EIS. As commenters noted, the California Endangered Species Act (CESA) requires the impacts of the Project on listed species be fully mitigated and not jeopardize the continued existence of the species, regardless of whether those impacts are designated as significant under CEQA. If, during the permitting process, CDFW indicates there are residual effects requiring mitigation to meet full mitigation standards under CESA, those effects will receive such mitigation by the Authority accordingly. Some comments suggested that the underlying CALSIM modeling is flawed, and, therefore, flow-survival effects of the Project alternatives based on CALSIM were not adequately analyzed. With respect to CALSIM modeling being flawed, please see Master Response 3, *Hydrology and Hydrologic Modeling*. Note that the Sites Reservoir Daily Divertible and Storable Flow Tool used for the migration flow-survival analyses in Appendix 11P is not based on CALSIM outputs.

Funks and Stone Corral Creeks

Multiple commenters expressed concern regarding maintaining flows in Funks and Stone Corral Creeks downstream of the main dams and to the Sacramento River, including flooding benefits for fish habitat in the CBD. The information on hydrology, species presence, and habitat characteristics for these streams is dated and limited in scope. The hydrologic record is a period of 27 years ending in 1985, and fish surveys were conducted only in the inundation zone in the summer and winter of 1998–1999. These are intermittent streams that may be used as “within stream” migration corridors by non-special-status resident fish species. Determining whether the stream reaches below Sites and Golden Gate Dams should be maintained as intermittent habitat or converted to perennial habitat will be done based on studies described in Chapter 2 and Appendix 2D. The goal of these studies is to update information of fish presences, habitat uses, and habitat quality to ensure decision regarding maintenance of these streams is consistent with regulatory requirements, including California Fish and Game Code (CFGC) Section 5937. The Project includes facilities to accommodate either intermittent migratory habitat or perennial habitat under Alternatives 1, 2, and 3. The suite of investigations described in Chapter 2 and Appendix 2D prior to Project construction will inform a decision of the initial operations for these streams. These streams are also included in the Project’s AMP so that conditions and operations may be monitored and adjusted as appropriate. Decision on compliance with CFGC Section 5937 will be made in consultation with and with the assistance of CDFW.

Longfin Smelt Impact Analysis and Mitigation

A number of comments were received related to the longfin smelt impact analysis and mitigation. This section summarizes and responds to the main topics raised in these comments, generally following the subheadings used in RDEIR/SDEIS Chapter 11, Impact FISH-9.

Entrainment

Comments received on the RDEIR/SDEIS suggested that potential increases in entrainment were ignored, but this potential was not ignored; rather, it was analyzed in the context of the limited potential differences. Comments summarized evidence for various indicators of entrainment risk, such as Old and Middle Rivers flow and X2. The RDEIR/SDEIS examined such indicators, explaining that there would be limited differences. Comments received expressed concern that differences in mean December–March X2 were categorized as "small" without describing a safe level of entrainment and that additional analysis of larval longfin smelt entrainment was necessary. The differences in mean X2 ranged from 0.1 to 0.5 kilometer (km) in the RDEIR/SDEIS and are even smaller [0.0 to 0.3 km] in the Final EIR/EIS because of differences in the operational criteria between the RDEIR/SDEIS and Final EIR/EIS, which appear reasonable to describe as small in the context of the distribution of longfin smelt over many tens of kilometers within the Bay-Delta (see Appendix 11A, *Aquatic Species Life Histories*). Note also that newly completed published analyses indicate that longfin smelt may hatch further seaward than previously believed and that south Delta entrainment of longfin smelt larvae is too low to measurably influence population dynamics (Kimmerer and Gross 2022; Gross et al. 2022). As described further below, south Delta operations under the Project alternatives and the NAA would continue based on the CDFW (2020) ITP for the SWP, thereby ensuring safe levels of south Delta exports are maintained so as not to jeopardize longfin smelt. Commenters did not acknowledge this, instead focusing on relatively small modeled differences in X2 and Old and Middle Rivers flows, which are part of the considerations related to south Delta operations management under the CDFW (2020) ITP for the SWP and would occur under the NAA and the Project alternatives. Comments on entrainment and the flow-related effects on longfin smelt also expressed concern regarding the use of mean values; see *Use of Means in Reporting Modeling Results* section above related to this topic.

Comments implied, based on citation of a paper related to delta smelt by Smith et al. (2021), that no additional mortality by entrainment of longfin smelt is sustainable. Given differences in ecology between delta smelt and longfin smelt, such as the latter being distributed farther downstream (see discussion in RDEIR/SDEIS Appendix 11A), it is unclear why conclusions made regarding delta smelt would also apply to longfin smelt. As the RDEIR/SDEIS noted, the indicators of entrainment risk showed little difference between the Project alternatives and the NAA, and that entrainment risk would continue to be limited under the CDFW (2020) ITP for the SWP, which would apply to the NAA and the Project alternatives. South Delta operations in the ITP include criteria that allowed CDFW to determine that operations would not jeopardize longfin smelt; therefore, their continuation under the NAA and the Project alternatives would not jeopardize longfin smelt because they account for prevailing entrainment risk conditions regardless of how those conditions arose (and, as described above, the analysis of the Project alternatives indicated little difference in these indicators). As also noted above, new research suggests that south Delta entrainment of longfin smelt larvae is too low to measurably influence population dynamics (Kimmerer and Gross 2022).

Flow-Related Effects

Some comments suggested that the Delta outflow criteria required under the CDFW 2020 ITP for the SWP (see further discussion below related to Mitigation Measure FISH-9.1) are not reasonably likely to occur, with examples given because of recent drought-related conditions. Note that, in these types of drought-related conditions, diversions to Sites Reservoir would be extremely restricted by operational criteria. For example, application of the Sites Reservoir Daily Divertible and Storable Flow Tool (see Attachment 11P-1, *Sites Reservoir Daily Divertible & Storable Flow Tool*, to Appendix 11P) to the Final EIR/EIS operational criteria estimates no diversions would have occurred in 2014 and very low diversions would have occurred in 2015 (approximately 11 TAF). As described in the operational criteria, many conditions, such as the Delta being in excess conditions and flows being above conditions required to meet existing regulatory requirements[6], would be required to be met to allow diversions to Sites Reservoir.

Comments suggested the analyses of potential effects on longfin smelt from outflow-abundance effects did not account for potential increases in entrainment mortality. As described above in the discussion of comments related to entrainment, the indicators of entrainment risk analyzed suggested limited differences between the Project alternatives and the NAA, and existing entrainment management under the CDFW (2020) ITP for the SWP would in any case be occurring to limit risk under the NAA and the Project alternatives. Comments suggested that the RDEIR/SDEIS analysis' reliance on historical relationships between flow and abundance indices ignored differences that could occur because of differences in entrainment mortality; however, although entrainment mortality may not be explicitly accounted for in the relationships, if, as argued elsewhere by the commenters, less outflow increases the potential for entrainment risk, then any such effects would be captured by the historical relationships, such that if there were any effects on abundance from changes in entrainment, those would also be captured by the outflow-abundance analysis.

A number of comments expressed concern about the use of the Nobriga and Rosenfield model for assessing potential Delta outflow-abundance effects on longfin smelt. Comments suggested that use of the model was not appropriate because it had not been intended to be a predictive model, although the comments did not suggest an alternative, more appropriate, model. Comments suggested that the differences between the Project alternatives and the NAA would compound over time because of the effect of population size in one generation affecting abundance in the next generation. However, as shown in the time series plot of the results of the Nobriga and Rosenfield analysis presented in the RDEIR/SDEIS (the Chapter 11 figure titled *95% Confidence Intervals of Longfin Smelt Fall Midwater Trawl Index by Water Year Type from Nobriga and Rosenfield [2016] Model*), there is no compounding trend evident (i.e., there is no decline evident over time), and the 95% probability intervals are very similar between the Project alternatives and the NAA. Commenters expressed concern in the presentation of results with 95% intervals, but such presentation is consistent with recommendations on similar analyses by

---

[6] See description of other regulatory requirements in Section 2.5.2.1 *Water Operations* in Final EIR/EIS Chapter 2.

peer-review panels (Simenstad et al. 2016:50) and accounts for uncertainty in the response to differences in Delta outflow. Commenters suggested that this type of presentation masked the effects of the alternatives, but the tabular summary addresses the differences in the mean estimates, which is analogous to the desire of commenters to have less emphasis on variation in model estimates. Presentation of violin plots in the manner used in the RDEIR/SDEIS may be misinterpreted by some (e.g., by considering them to be point estimates of variability around a single mean level of flow), so these plots have been removed from the Final EIR/EIS. Various comments suggested that the results of the analysis should focus on summaries of annual differences in estimates of abundance, but this would be contrary to appropriate use of CALSIM-based modeling (see *Use of Means in Reporting Modeling Results* discussed above; see also Master Response 3). In any case, mean percentage differences between scenarios would be very similar to percentage differences between mean abundance. The new Delta outflow-abundance analysis (see below) provides a summary of the probability of the Project alternatives having lower abundance than the NAA, thereby quantifying the probability of differences between scenarios.

A new Delta outflow-abundance index analysis aiming to address shortcomings noted by commenters was added to the Final EIR/EIS, with results generally similar to the analysis based on the Nobriga and Rosenfield and X2-abundance analyses. This new method uses a Bayesian model-averaging approach to allow a suite of competing models to contribute to results, weighted by the statistical evidence for each model being the best explanation for the trends in the data (see Final EIR/EIS, Appendix 11M, for description). The model assumes a monotonic relationship between Delta outflow and fall midwater trawl abundance index and therefore should be conservative relative to the strongly density-dependent Ricker stock-recruitment relationship that commenters noted may have led to underpredictions of differences in modeled scenarios when the index of parental stock size (i.e., fall midwater trawl index 2 years earlier) was relatively high. Inclusion of parental stock size as a predictor of fall midwater trawl index addressed shortcomings of the X2-abundance regression approach, which did not have such a predictor in the statistical model (see discussion below).

Some comments suggested that use of the X2-abundance regression (also referred to as the “Kimmerer regression” in the RDEIR/SDEIS, page 11-273) was very coarse and should be used to evaluate only the likely relative effects of Project alternatives. As with all the analyses included, the purpose was indeed to assess the relative effects of the Project alternatives compared to the NAA. As noted in the comments, the X2-abundance regression method is limited in that it does not account for prior abundance. The X2-abundance regression analysis was included, however, because it had recently been used by California Department of Water Resources (2020) at the behest of CDFW; the California Department of Water Resources (2020:Appendix E, Attachment 2:E2-1) had also noted limitations in the method. The results of the X2-abundance regression analysis in the RDEIR/SDEIS, however, were consistent with the results from the Nobriga and Rosenfield model undertaken for the analysis; the X2-abundance regression analysis has also been updated with modeling for the Final EIR/EIS and again is consistent with the new Delta outflow-abundance index method added to the Final EIR/EIS to address limitations with the Nobriga and Rosenfield analysis.

Mitigation Measure FISH-9.1: Tidal Habitat Restoration for Longfin Smelt

A number of comments expressed concern that the proposed mitigation for outflow effects on longfin smelt did not reduce the impact to less than significant. As described further below, the extent of proposed mitigation reflects the relatively small and uncertain potential difference in longfin smelt abundance as a result of differences in outflow. Comments indicated there has been little study of restoration effects, which is correct, but the proposed mitigation is based on a method used previously and noted to expand the diversity, quality, and quantity of rearing habitat for longfin smelt (California Department of Fish and Wildlife 2020:112, as cited in the RDEIR/SDEIS). Monitoring in restored areas other than those cited by the commenter has found longfin smelt (e.g., in Tule Red Tidal Restoration adjacent to Grizzly Bay; Environmental Science Associates 2021:4-34).

Comments suggested that the mitigation method calculation based on Kratville (2010) may not be appropriate because it was originally applied to delta smelt and covers the period from February to June, whereas longfin smelt larvae may be present as early as mid-December; therefore, comments suggested that the equation may be appropriate if including December and January. Although it is correct that the method originally was also applied to delta smelt, the method also was used as part of longfin smelt mitigation requirements under the 2009 ITP for SWP operations (California Department of Fish and Game 2009:14), as well as the CDFW 2020 ITP for SWP Operations (as described in the EIR/EIS Appendix 11F, *Smelt Analysis*, *Delta Outflow–Longfin Smelt Abundance Analysis (Based on Nobriga and Rosenfield 2016)* section). A comment suggested that the method does not account for impacts associated with reduced Delta outflow due to proposed Project diversions. However, tidal habitat mitigation has been applied to mitigate flow-related effects, as reflected in the 2009 and 2020 ITPs for the SWP. Those permits also included flow-related measures. As described in Chapter 2, *Operations and Maintenance Common to Alternatives 1, 2, and 3*, *Water Operations* section of the Final EIR/EIS, the Project alternatives allow diversions only when Sacramento River flows are available for diversion above flows needed to meet all applicable laws, regulations, biological opinions, ITPs, and court orders in place at the time that diversion occurs; these include the 2020 ITP for the SWP, which includes Delta outflow criteria for longfin smelt and other species (California Department of Fish and Wildlife 2020:102–104). Tidal habitat restoration proposed to address the Final EIR/EIS Impact FISH-9 accounts for the incremental difference in Delta inflow as a result of operations of the Project alternatives. Note that the acreage of tidal habitat restoration for flow-related impacts on longfin smelt has been revised in the Final EIR/EIS as result of changes in proposed operations and is now approximately 5–10 acres, as described in Impact FISH-9. The mitigation is considered sufficient to meet CEQA requirements to reduce the impact to less than significant, based on such mitigation having been applied previously (see discussion above); as part of the Authority's CESA process for the proposed Project, CDFW will consider whether any other requirements are necessary to meet the full mitigation standard.

Comments received expressed concern that the benefits of tidal habitat restoration mitigation would occur only in years when local streamflows and Delta outflows are high, seemingly as a result of assuming that restoration would occur west and south of the Carquinez Strait. In fact, Mitigation Measure FISH-9.1 makes no such assumptions regarding geographic location of tidal habitat restoration, and, as noted above, longfin smelt have been found in restored areas east of the Carquinez Strait (Environmental Science Associates 2021:4-34). Requirements associated with restoration mitigation under Mitigation Measure FISH-9.1 will likely specify the timeframe associated with restoration; for example, whether the mitigation should be completed prior to Project operations, which was a concern expressed by comments.

Delta Smelt Impact Analysis and Mitigation

A number of comments were received related to the delta smelt impact analysis and mitigation. This section summarizes and responds to the main topics raised in these comments, generally following the subheadings used in RDEIR/SDEIS Chapter 11, Impact FISH-8.

General

Commenters suggested that the RDEIR/SDEIS incorrectly concluded that the proposed Project and alternatives would not cause significant adverse impacts on delta smelt by assuming that changes less than 5% cannot constitute a significant impact. As discussed above in the section regarding *Thresholds and Criteria Used in Analyses*, 5% was not used as a specific threshold for significance determinations.

Effects from Reservoir Releases to Colusa Basin Drain/Yolo Bypass

Comments received on the analysis of the effects of reservoir releases to CBD/Yolo Bypass expressed concerns that the RDEIR/SDEIS mischaracterized the study of Bush (2017) in stating that an average of 23% of the delta smelt population may benefit from releases through the Yolo Bypass and that this was not an accurate characterization of Bush (2017). The EIR/EIS does not state that 23% of the delta smelt population may benefit from reservoir releases through Yolo Bypass; the analysis merely provides perspective on the proportion of the population residing in the region mostly likely to benefit from the releases. The commenters also noted that the proportion of freshwater residents was variable depending on environmental conditions (in particular, summer water temperature); a summary of this information has been added to the Final EIR/EIS in this section.

Commenters expressed concern that north Delta food web actions of water released through the Yolo Bypass have not demonstrated a measurable improvement in the delta smelt population, habitat, or abundance of prey items. It is unclear to which specific studies this comment is referring. The EIR/EIS summarizes available information, noting that additional studies are underway. Commenters further noted that the only year of previous north Delta food web action implementation coinciding with phytoplankton blooms was 2016, during which phytoplankton comprising *Aulacoseira*, which is a long chain-forming diatom that copepod prey of delta smelt and longfin smelt do not consume at high rates during blooms (Jungbluth et al. 2021). Acknowledgement of this has been added to the Final EIR/EIS, including citation of the reference provided.

Commenters expressed concern that there could be negative effects on delta smelt from reservoir releases as a result of increases in pesticides, low dissolved oxygen, or increased water temperature, as acknowledged in the RDEIR/SDEIS. Commenters implied that increases in water temperature in the Yolo Bypass or north Delta as a result of Sites Reservoir water release would be likely to reduce the frequency of freshwater resident delta smelt. The uncertainty in potential negative effects from reservoir releases on delta smelt as a result of effects on temperature, dissolved oxygen, and pesticides is acknowledged in the EIR/EIS, and the impact is concluded to be significant. Mitigation Measures FISH-8.1 and WQ-2.2 reduce the impact to less than significant. Comments on Mitigation Measure FISH-8.1 suggested the measure to be unlawful because it does not include specific performance criteria, instead deferring to future development of criteria with fishery agencies. However, given the need to develop criteria that are acceptable to fishery agencies, and particularly given that reservoir releases will be implemented and evaluated as part of the Project's funded ecosystem benefits under WSIP that are at the discretion of CDFW, the development of criteria is appropriately treated in the EIR/EIS.

Flow-Related Effects

Commenters suggested that the RDEIR/SDEIS should have included analysis of spring outflow-related variables on delta smelt. Commenters noted that the recent Temporary Urgency Change Petition by Reclamation and DWR indicated that Polansky et al. (2021) found evidence for March–May X2 and E:I (ratio of exports to total Delta inflow) being related to delta smelt recruitment and that this should have been discussed in the RDEIR/SDEIS. Given that Polansky et al. (2021) specifically mentioned in discussion only E:I, and the subsequent analysis by Smith et al. (2021) based on Polansky et al. (2021) did not use either E:I or X2 because they were not among the variables meeting the threshold for inclusion in their analysis, only analysis of E:I was added to the Final EIR/EIS. (Note that discussion of X2 was provided in the RDEIR/SDEIS in the context of the analysis of larval/early juvenile delta smelt south Delta entrainment risk.) Given that E:I is an indicator of hydrodynamics, as shown by analyses such as Kimmerer and Nobriga (2008), inclusion of the analysis of E:I in the Final EIR/EIS also addresses the suggestion in other comments that assessment of delta smelt larval transport and dispersal be included. As such comments noted, Polansky et al. (2021) found that outflow (specifically in June–August) is related to postlarval delta smelt survival. This was the only flow-related variable examined by Polansky et al. (2021) meeting the threshold for inclusion in the analysis by Smith et al. (2021), which was based on variables assessed by Polansky et al. (2021). Accordingly, analysis of June–August outflow was also added to the Final EIR/EIS.

With respect to the analysis of the delta smelt prey *Eurytemora affinis* presented in the RDEIR/SDEIS, commenters suggested that results should be presented on a monthly basis for March, April, and May separately rather than based on a 3-month averaging period. This would not be consistent with prior (Kimmerer 2002) and more recent analyses (Hennessy and Burris 2017; Greenwood 2018) that were all cited in the EIR/EIS, which also used a several-month averaging period indicating the general springtime period of correlation with *E. affinis* with Delta outflow and X2. The analysis of *E. affinis* provided in the EIR/EIS cross-referenced monthly differences in X2 and Delta outflow, noting that differences in March are greater than those in April and May. As shown in the Final EIR/EIS, Appendix 5B, and the analysis in Impact FISH-8, the differences in mean Delta outflow in March are relatively small (ranging from -4% to 0%).

Commenters suggested that while the RDEIR/SDEIS acknowledged that diversions by the proposed Project and alternatives could reduce abundance of zooplankton prey (*Pseudodiaptomus forbesi*) for delta smelt in the low salinity zone, the RDEIR/SDEIS improperly concluded this reduction would not be a significant impact because the changes in abundance of *P. forbesi* would be less than 5%. However, the analysis of potential effects on *P. forbesi* considered two aspects, rather than only the one mentioned by commenters. The first aspect analyzed was differences in Delta outflow, which as the analysis notes, has been positively correlated with *P. forbesi*. The comment, however, did not mention this aspect of the analysis or that the RDEIR/SDEIS found a positive difference for the Project alternatives relative to the NAA in this regard (reflecting greater Delta outflow under the Project alternatives, shown by a summary of July–September Delta outflow, as well as the regression based on June–September Delta outflow from Hennessy and Burris [2017]). The second aspect analyzed was the potential for *P. forbesi* south Delta entrainment and negative effects on central Delta hydrodynamics as expressed by QWEST (i.e., mean flow in the San Joaquin River near Jersey Point), which is the aspect that the commenter notes. Rather than strict examination of a 5% threshold suggested by commenters, the analysis summarized the differences in the key months (July, August, and September) to note that, while there was some evidence of potential negative effects, there is uncertainty in the potential for differing effects given other factors, such as clam grazing and the few years with positive QWEST under the Project alternatives and the NAA. Overall, given the two aspects analyzed (i.e., potential positive effect from increase in Delta outflow, potential negative effect from decreased QWEST) and the relatively small difference between the Project alternatives and the NAA, a conclusion of limited differences between the Project alternatives and the NAA was made. As illustrated above, this conclusion was based on appreciably more consideration than implied by comments.

Commenters suggested that the RDEIR/SDEIS discussion of low salinity zone habitat effects on delta smelt states that the low salinity zone is not important habitat for delta smelt and that this contradicts other statements that the majority of delta smelt reside in the low salinity zone (based on the citation of Bush [2017]). However, the RDEIR/SDEIS did acknowledge that there is debate regarding the importance of low salinity habitat, citing examples of references discussing the topic, rather than stating that the low salinity zone is not important habitat. On this topic, commenters suggested that the discussion be expanded to include other literature; for example, recent statistical analysis by Polansky et al. (2021) finding statistical evidence for fall habitat being related to recruitment of delta smelt. In response, additional analysis of differences in fall habitat (as indexed by X2, the variable assessed by Polansky et al. 2021) has been added to the Final EIR/EIS. Note that commenters suggested that there was “strong” support for fall habitat (X2) being found by Polansky et al. (2021); fall X2 was considered to have substantial enough evidence to be reported on by Polansky et al. (2021), but the subsequent analysis by Smith et al. (2021) based on Polansky et al. (2021) did not use fall X2 because it was not among the variables meeting the threshold for inclusion in their analysis.

Upstream Sediment Entrainment

Commenters expressed concern that a reduction in sediment loading under the Project alternatives of up to 5% may be a significant impact on delta smelt. As noted in the EIR/EIS, this assessment was based on the 2017 Draft EIR/EIS alternatives, which are conservatively higher but generally representative of the Final EIR/EIS. As described in the RDEIR/SDEIS discussion of *Upstream Sediment Entrainment* in Impact FISH-8, the up to 5% sediment entrainment under the 2017 Draft EIR/EIS project alternatives was greater compared to the around 3% entrainment under baseline conditions; thus, there was a net increase of around 2% in sediment entrained. To address other comments suggesting that modeling specific to the present EIR/EIS be added, estimates of sediment entrainment specific to proposed operations were added to the Final EIR/EIS in Appendix 11F. This analysis estimated sediment entrainment at the Red Bluff intake to be 2.6%–2.7% under the Project alternatives and 1.2% under the NAA and estimated sediment entrainment at the Hamilton City intake to be 2.1% under the Project alternatives and 1.8% under the NAA. As the commenters noted, the RDEIR/SDEIS concluded the sediment entrainment impact to be less than significant. Commenters suggested that the magnitude of the change in sediment entrainment *and* potential mitigation measures led to this finding. The RDEIR/SDEIS in fact did not propose mitigation measures to find this potential impact to be less than significant. Given uncertainty in the potential for effect, particularly in light of projected potential future increases in sediment loading to the Delta as discussed in the EIR/EIS (Stern et al. 2020), the EIR/EIS includes technical studies and adaptive management to address the issue further, as described in the Appendix 2D *Sediment Monitoring Plan and Adaptive Management for Sediment Diverted from the Sacramento River* section of the EIR/EIS. Commenters suggested that this is unlawful deferment of mitigation and that there are no specific performance criteria identified. As noted, this plan and adaptive management is not mitigation, and, as discussed in the *Sediment Technical Studies Plan and Adaptive Management for Sacramento River* section, specific performance criteria would be developed with the input of the proposed Sediment Technical Team and independent peer review.

Commenters suggested that "other agencies have previously concluded that any reduction in sediment supply to the Delta and San Francisco Bay should be considered a significant impact," citing the Bay Conservation and Development Commission's comments on the Bay-Delta Conservation Plan (Exhibit 3 to Letter 66; comment 66-92). However, comments made in that document were specific to estimated suspended sediment transport of approximately 8% to 10% in the Bay-Delta Conservation Plan EIR (Letter 66, Attachment 3:4) and only indicated that the project did not characterize such a change as a significant impact before providing further comments on the impacts.

Commenters suggested that the RDEIR/SDEIS failed to evaluate whether the potential mitigation measures for sediment reintroduction are feasible, citing prior work done for the California WaterFix project, which suggested limited quantities of sediment could be reused. To clarify, the issue identified for the California WaterFix project was specifically that the configuration of diversion facilities was such that finer sediment associated with turbidity (a component of delta smelt habitat) generally would not be retained in that project's sediment basins at the intakes (Simenstad et al. 2016:16–17). In that evaluation of the California WaterFix project, it was subsequently noted that suspended sediment not retained at the intakes may have settled elsewhere in the water conveyance system, specifically in Clifton Court Forebay (Simenstad et al. 2016:38). The *Sediment Monitoring Plan and Adaptive Management for Sediment Diverted from the Sacramento River* section of Appendix 2D recognizes that under the Project various sources/locations of sediment for reintroduction may be considered (including those unrelated to the Project) and also recognizes that alternative means of achieving performance criteria such as tidal habitat restoration may also be considered, should performance criteria not be met.

In light of the information summarized in the above paragraphs on the issue of sediment entrainment, the Authority considers the proposed approach reasonable to address the sediment entrainment issues. With respect to endangered species, including delta smelt, Project permitting will determine whether permitting requirements are necessary, particularly with respect to the full mitigation standard for the ITP process under CESA.

References Cited

Bush, E. E. 2017. *Migratory Life Histories and Early Growth of the Endangered Estuarine Delta Smelt* (Hypomesus transpacificus). MS thesis. University of California, Davis. Davis, CA.

California Department of Fish and Game. 2009. *California Endangered Species Act Incidental Take Permit No. 2081-2009-001-03*. Department of Water Resources California State Water Project Delta Facilities and Operations. Yountville, CA: California Department of Fish and Game, Bay-Delta Region.

California Department of Fish and Wildlife. 2020. *California Endangered Species Act Incidental Take Permit No. 2081-2019-066-00*. Long-Term Operation of the State Water Project in the Sacramento San Joaquin Delta. Sacramento, CA: California Department of Fish and Game, Ecosystem Conservation Division.

California Department of Water Resources. 2020. *Final Environmental Impact Report for Long-term Operation of the California State Water Project*. State Clearinghouse No. 2019049121. March.

Environmental Science Associates. 2021. *Tule Red Tidal Restoration.* Annual Monitoring Report – Year 1 2020 Prepared for Westervelt Ecological Services and State and Federal Water Contractors Agency. February.

Greenwood, M. 2018. *Potential Effects on Zooplankton from California WaterFix Operations.* Technical Memorandum to California Department of Water Resources. July 2. Available: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/part2_rebuttal/dwr_1349.pdf. Accessed: June 28, 2022.

Gross, E., W. Kimmerer, J. Korman, L. Lewis, S. Burdick, and L. Grimaldo. 2022. Hatching Distribution, Abundance, and Losses to Freshwater Diversions of Longfin Smelt Inferred Using Hydrodynamic and Particle-Tracking Models. *Marine Ecology Progress Series* 700:179–196.

Hassrick, J. L., A. J. Ammann, R. W. Perry, S. N. John, and M. E. Daniels. 2022. Factors Affecting Spatiotemporal Variation in Survival of Endangered Winter-Run Chinook Salmon Out-Migrating from the Sacramento River. *North American Journal of Fisheries Management* 42(2):375–395. Available: https://doi.org/10.1002/nafm.10748.

Henderson, M. J., I. S. Iglesias, C. J. Michel, A. J. Ammann, and D. D. Huff. 2019. Estimating Spatial-Temporal Differences in Chinook Salmon Outmigration Survival with Habitat and Predation Related Covariates. *Canadian Journal of Fisheries and Aquatic Sciences* 76(9):1549–1561.

Hennessy, A., and Z. Burris. 2017. *Preliminary Analysis of Current Relationships between Zooplankton Abundance and Freshwater Outflow in the Upper San Francisco Estuary*. Memorandum to S. Louie, Senior Environmental Scientist, California Department of Fish and Wildlife, Water Branch. February 21. Stockton, CA: California Department of Fish and Wildlife, Bay-Delta Region.

Jungbluth, M., C. Lee, C. Patel, T. Ignoffo, B. Bergamaschi, and W. Kimmerer. 2021. Production of the Copepod *Pseudodiaptomus forbesi* Is Not Enhanced by Ingestion of the Diatom *Aulacoseira granulata* during a Bloom. *Estuaries and Coasts* 44:1083–1099.

Kimmerer, W., and E. Gross. 2022. Population Abundance and Diversion Losses in a Threatened Estuarine Pelagic Fish. *Estuaries and Coasts* 45:2728–2745.

Kimmerer, W. J. 2002. Physical, Biological, and Management Responses to Variable Freshwater Flow into the San Francisco Estuary. *Estuaries* 25:1275–1290.

Kimmerer, W. J., and M. Nobriga. 2008. Investigating Particle Transport and Fate in the Sacramento San Joaquin Delta Using a Particle Tracking Model. *San Francisco Estuary and Watershed Science* 6(1).

Kratville, D. 2010. *California Department of Fish and Game Rationale for Effects of Exports*. California Department of Fish and Game, Sacramento, CA.

Michel, C. J. 2019. Decoupling Outmigration from Marine Survival Indicates Outsized Influence of Streamflow on Cohort Success for California's Chinook Salmon Populations. *Canadian Journal of Fisheries and Aquatic Sciences* 76:1398–1410.

Michel, C., J. Notch, F. Cordoleani, A. Ammann, and E. Danner. 2021. Nonlinear Survival of Imperiled Fish Informs Managed Flows in a Highly Modified River. *Ecosphere*. Available: https://doi.org/10.1002/ecs2.3498.

Munsch, S. H., C. M. Greene, R. C. Johnson, W. H. Satterthwaite, H. Imaki, and P. L. Brandes. 2019. Warm, Dry Winters Truncate Timing and Size Distribution of Seaward-Migrating Salmon across a Large, Regulated Watershed. *Ecological Applications* 29(4):e01880.

Munsch, S. H., C. M. Greene, R. C. Johnson, W. H. Satterthwaite, H. Imaki, P. L. Brandes, and M. R. O’Farrell. 2020. Science for Integrative Management of a Diadromous Fish Stock: Interdependencies of Fisheries, Flow, and Habitat Restoration. *Canadian Journal of Fisheries and Aquatic Sciences* 77(9):1487–1504.

Notch, J. J., A. S. McHuron, C. J. Michel, F. Cordoleani, M. Johnson, M. J. Henderson, and A. J. Ammann. 2020. Outmigration Survival of Wild Chinook Salmon Smolts through the Sacramento River during Historic Drought and High Water Conditions. *Environmental Biology of Fishes*.

Perry, R. W., A. C. Pope, J. G. Romine, P. L. Brandes, J. R. Burau, A. R. Blake, A. J. Ammann, and C. J. Michel. 2018. Flow-Mediated Effects on Travel Time, Routing, and Survival of Juvenile Chinook Salmon in a Spatially Complex, Tidally Forced River Delta. *Canadian Journal of Fisheries and Aquatic Sciences* 75(11):1886–1901.

Polansky, L., K. B. Newman, and L. Mitchell. 2021. Improving Inference for Nonlinear State-Space Models of Animal Population Dynamics Given Biased Sequential Life Stage Data. *Biometrics* 77(1):352–361.

Simenstad, C., J. Van Sickle, N. Monsen, E. Peebles, G. T. Ruggerone, and H. Gosnell. 2016. *Independent Review Panel Report for the 2016 California WaterFix Aquatic Science Peer Review*. Sacramento, CA: Delta Stewardship Council, Delta Science Program.

Smith, W. E., L. Polansky, and M. L. Nobriga. 2021. Disentangling Risks to an Endangered Fish: Using a State-Space Life Cycle Model to Separate Natural Mortality from Anthropogenic Losses. *Canadian Journal of Fisheries and Aquatic Sciences* 78(8):1008–1029.

Stern, M. A., L. E. Flint, A. L. Flint, N. Knowles, and S. A. Wright. 2020. The Future of Sediment Transport and Streamflow Under a Changing Climate and the Implications for Long-Term Resilience of the San Francisco Bay-Delta. *Water Resources Research* 56(9):e2019WR026245.