

Appendix 11H Salmonid Population Modeling (SALMOD)

This appendix was extensively revised after publication of the RDEIR/SDEIS. Because the model output revisions were extensive, individual changes from the RDEIR/SDEIS are not identified.

Appendix 11H Salmonid Population Modeling (SALMOD)

11H.1 Introduction

This appendix provides SALMOD model outputs for the Project. SALMOD simulates Sacramento River populations of winter-run, spring-run, fall-run, and late fall-run Chinook salmon to assess potential flow- and temperature-related effects on early life stages. The interpretation of SALMOD outputs presented in this appendix is provided in Chapter 11, *Aquatic Biological Resources*, for Impacts FISH-2, FISH-3, and FISH-4.

11H.2 SALMOD

SALMOD simulates the population dynamics of the freshwater life stages of anadromous Chinook salmon. Model processes include spawning (egg deposition), egg and alevin development and growth, mortality, and movement (due to habitat limitation, freshets, and seasonal stimuli). Pre-smolts do not graduate to the smolt stage within the model. Instead, they exit the study area and the population is reinitialized with survey estimates of spawning adults each biological year. SALMOD is a spatially explicit model in which habitat quality and carrying capacity are characterized by the hydraulic and thermal properties of individual mesohabitats, which serve as spatial computational units in the model. SALMOD is organized around events occurring during a biological year beginning with spawning and typically concluding with fish that are physiologically “ready” (e.g., pre-smolts), swimming downstream toward the ocean. It operates on a weekly timestep for one or more biological years. Input variables (e.g., streamflow, water temperature, number and distribution of adult spawners) are represented by their weekly average values. SALMOD tracks a population of spatially distinct cohorts that originate as eggs and grow from one life stage to another as a function of local water temperature. The biological characteristics of fish within a cohort are the same. Fish cohorts are tracked by life stage and size class within the spatial computational units. SALMOD uses the weekly averages of the daily flow outputs from the Upper Sacramento River Daily Operations Model (USRDOM) and the daily temperature outputs from the HEC5Q model. The USRDOM model is described in Appendix 5C, *Upper Sacramento River Daily River Flow and Operations Model*, and the HEC5Q model is described in Appendix 5A, *Surface Water Resources Modeling of Alternatives*.

A full description of the model can be found in the California WaterFix Biological Assessment (ICF International 2016), Attachment 5.D.2, *SALMOD Model*.

11H.3 Results

The following crosswalk defines the titles used in figures and tables presented in this appendix:

- NOACTION 051422 = No Action Alternative (NAA)¹
- ALT1A 051722 = Alternative 1A
- ALT1B 051722 = Alternative 1B
- ALT2 051722 = Alternative 2
- ALT3 051722 = Alternative 3

Table 1a-1 through Table 1d-4 compare the mortality of each Chinook salmon race by life stage and source between the NAA and Alternatives 1A, 1B, 2, and 3. Table 2a-1 through Table 2d-4 compare the annual potential production of each Chinook salmon race between the NAA and Alternatives 1A, 1B, 2, and 3. Figure B-a-1 through Figure B-d-19 provide exceedance plots of SALMOD outputs for all alternatives for winter-run, spring-run, fall-run, and late fall-run Chinook salmon for multiple metrics. These metrics include annual mortality, habitat-based mortality, and temperature-based mortality for early life stages.

Section	Output Parameter	Table Numbers	Figure Numbers
Tabular Results	Mortality by Life-stage and Source	1a-1 through 1d-4	NA
Tabular Results	Annual Potential Production	2a-1 through 2d-4	NA
Figure Results	Winter Run	NA	B-a-1 through B-a-19
Figure Results	Spring Run	NA	B-b-1 through B-b-19
Figure Results	Fall Run	NA	B-c-1 through B-c-19
Figure Results	Late Fall Run	NA	B-d-1 through B-d-19

11H.4 References Cited

ICF International. 2016. *Biological Assessment for the California WaterFix*. July. (ICF 00237.15.) Sacramento, CA. Prepared for the U.S. Department of the Interior, Bureau of Reclamation, Sacramento, CA.

¹ The term *NAA*, which is identical to the No Project Alternative, is used throughout 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*.